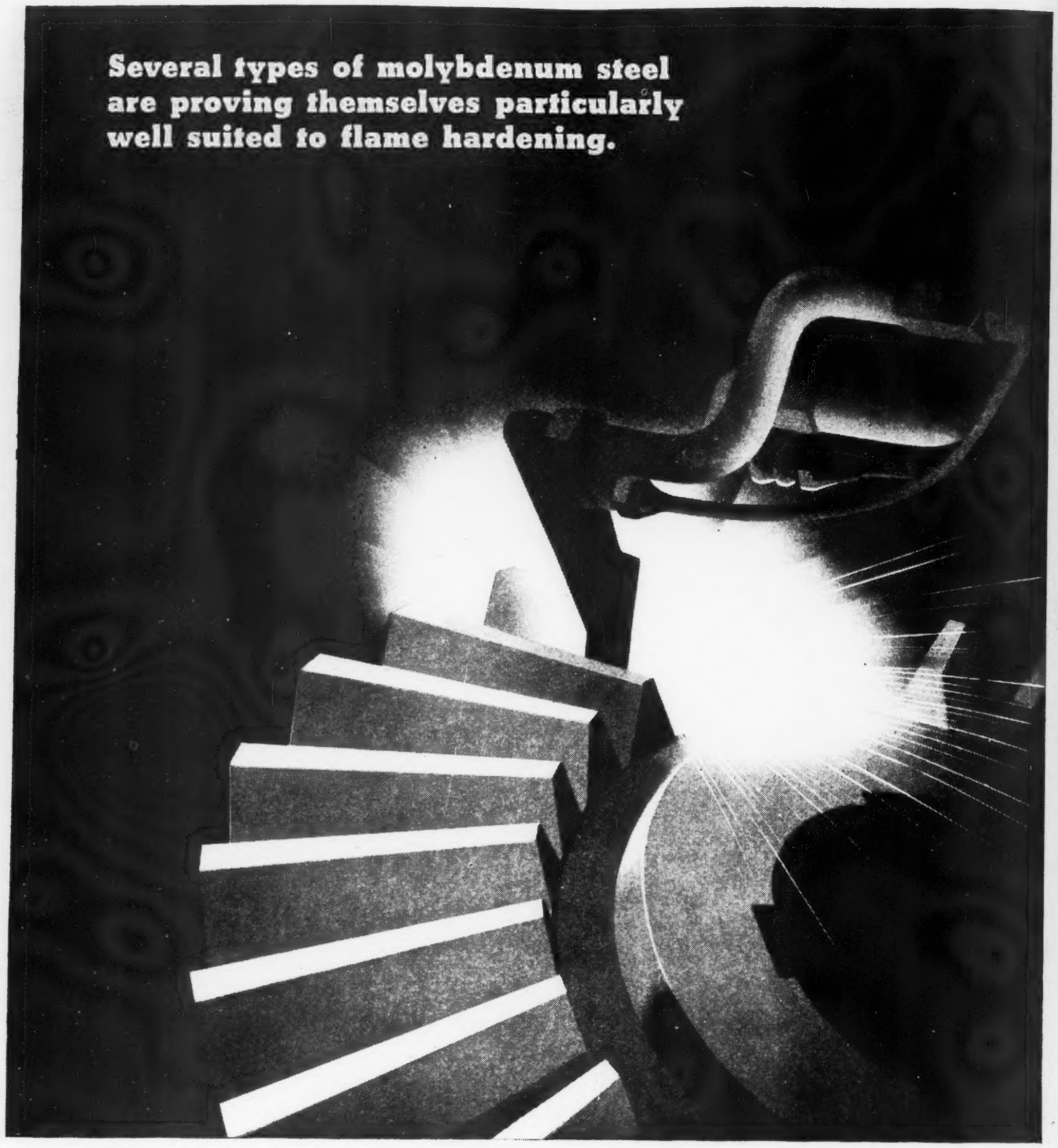
THE TECH ENGINEERING NEWS

VOLUME XXVI
NUMBER 9

1945

Several types of molybdenum steel are proving themselves particularly well suited to flame hardening.



CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

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Climax Molybdenum Company

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CLEANING STEEL with BRUSHES of FLAME

Without paint protection, the strongest exposed steel structures would eventually succumb to rust. Now modern flame-cleaning makes paint cling closer to steel, forming a better, longer-lasting shield against corrosion. It speeds repainting by rapidly cleaning and dehydrating the surface to receive the priming coat.

This process is one of many advanced metal-treating methods fostered by Air Reduction. Valuable in war, these methods promise even greater usefulness when peace returns.

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MAGNOLIA AIRCO GAS PRODUCTS CO.
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OXYGEN, ACETYLENE AND OTHER ATMOSPHERIC GASES • GAS WELDING AND CUTTING APPARATUS • CALCIUM CARBIDE
ARC WELDING MACHINES AND SUPPLIES • CARBON DIOXIDE • "DRY ICE" • ANAESTHETIC AND THERAPEUTIC GASES AND APPARATUS

FOR *Greater Success* IN ENGINEERING

Learn to know your Bearings

A thorough knowledge of Timken Bearing design and application will be one of your best assets when you graduate to enter the professional engineering field. Begin to acquire it now. Here are the three most important features exemplified in the design of the Timken Bearing.

1. TRUE ROLLING MOTION

This basic necessity is assured by making all lines coincident with the tapered surfaces of the rollers, cup and cone, meet at a common apex on the axis of the bearing, Figure 1. True rolling motion always has been incorporated in the Timken Bearing.

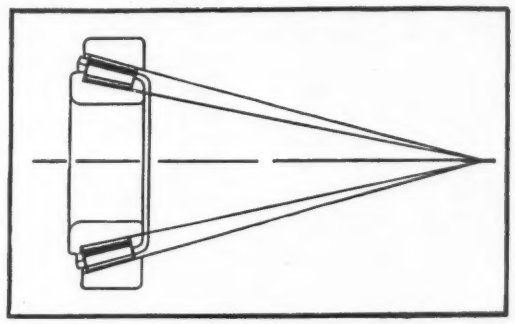


FIGURE 1

2. POSITIVE ROLLER ALIGNMENT

During the development of the Timken Bearing, as speed, load and accuracy requirements increased, various methods were used to stabilize the rollers and prevent them skewing in the raceways. The solution was found in establishing wide-area contact between the large ends of the rollers and the undercut rib of the cone, thus assuring constant and accurate roller alignment around the periphery of the raceways. The light areas on the ends of the rollers in Figure 2, show contact of rollers with undercut rib of cone.

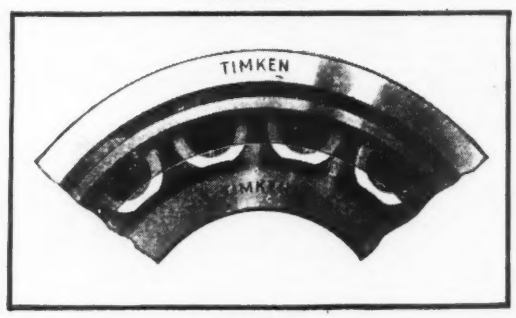


FIGURE 2

3. MULTIPLE PERFORATED CAGE

All the openings in the Timken Bearing cage, Figure 3, are stamped out in one operation by means of multiple perforating dies made to extremely close precision tolerances. This assures exact center-to-center spacing of the rollers around the periphery of the raceways, so that every roller takes its full share of the load when the bearing is in operation.

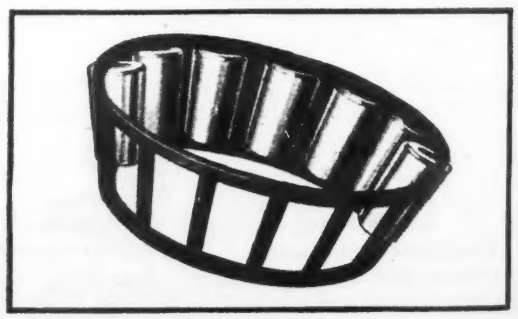
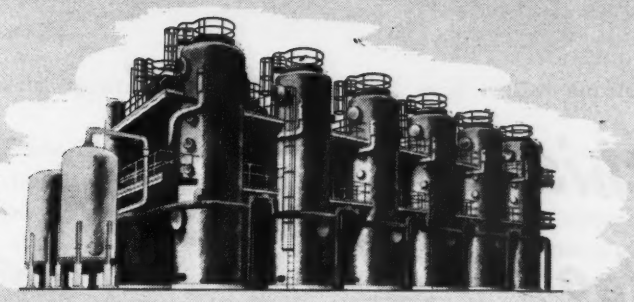


FIGURE 3

THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO



UNION CARBIDE *AGAIN* REPORTS

on the production of

BUTADIENE

for the Government's Synthetic Rubber Program

ONE OF THE MOST IMPORTANT factors in the Government's rubber program is the production of GR-S type synthetic rubber.

The basic chemical in this rubber is Butadiene, which can be made from alcohol or hydrocarbon materials.

The Government's original plan provided that about one third of the required Butadiene would be made by CARBIDE AND CARBON CHEMICALS CORPORATION'S alcohol process.

In 1943, their first year of operation, however, the plants using this process produced over 75 per cent of all Butadiene made for GR-S type synthetic rubber.

In 1944, the second year, these plants produced about 64 per cent of all Butadiene necessary for military and essential civilian rubber. This was true despite the fact that good progress had been made in the production of Butadiene by other processes.

THE RECORD

The first tank-car load of Butadiene was shipped from the Government's Carbide-built, Carbide-operated plant at Institute, West Virginia a little over two years ago.

This was just five months after the famous Baruch Committee Report pointed out this nation's desperate need for rubber—and approved Carbide's butadiene alcohol process, originally selected by Rubber Reserve Company, as one of the solutions.

In its first year the Institute plant, with a rated capacity of 80,000 tons per year, produced enough Butadiene for more than 90,000 long tons of synthetic rubber.

Two more great plants using Carbide's alcohol process—and built from the blueprints of the Institute plant—are in full production. One of these, with an annual rated capacity of 80,000 tons of Butadiene is located at Kobuta, Pennsylvania and is operated for the Government by another important chemical company.

The second, with a rated capacity of 60,000 tons a year, is operated for the Government by Carbide at Louisville, Kentucky—making the total rated capacity of the two huge plants now operated by Carbide 140,000 tons a year.

In 1944, the production of Butadiene from the three plants using the alcohol process totaled 361,000 tons—representing operation at over 164 per cent of rated capacity. An even higher rate is expected in 1945.

* * * * *

Before Pearl Harbor, the United States was a "have not" nation with respect to rubber. Now, thanks to American research, engineering and production skill, our country can take its place as a dominant factor among the great rubber producing nations of the world.

▼

Business men, technicians, teachers, and others are invited to send for the book XX12 "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol," which explains what these plants do, and what their place is in the Government's rubber program.

SEPTEMBER 10, 1942

"Of all the critical and strategic materials, rubber is the one which presents the greatest threat to the safety of our nation, and to the Allied Cause.... We find the situation to be so dangerous that unless corrective measures are taken immediately the country will face both a military and a civilian collapse."

—Report of the Rubber Survey Committee (Baruch Committee).

AUGUST 31, 1944

"Undoubtedly the outstanding achievement of your company has been the development of your process for the production of Butadiene from alcohol. With a rather meager background of experimental work, your engineers were able to design and construct commercial units for the production of Butadiene. In an exceedingly short time, the operation of this equipment at capacities up to 200 per cent of rating has been largely responsible for our present safe situation with respect to rubber supplies..."

—Letter from Rubber Director Bradley Dewey to CARBIDE AND CARBON CHEMICALS CORPORATION

The material herein has been reviewed and passed by the Rubber Reserve Company, the Defense Plant Corporation, and the War Department.

BUY UNITED STATES WAR BONDS AND STAMPS

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC **New York 17, N. Y.**

Principal Units in the United States and their Products

ALLOYS AND METALS—Electro Metallurgical Company, Haynes Stellite Company, Kemet Laboratories Company, Inc., United States Vanadium Corporation
CHEMICALS—Carbide and Carbon Chemicals Corporation **PLASTICS**—Bakelite Corporation **ELECTRODES, CARBONS & BATTERIES**—National Carbon Company, Inc.
INDUSTRIAL GASES AND CARBIDE—The Linde Air Products Company, The Oxweld Railroad Service Company, The Prest-O-Lite Company, Inc.

Isn't this something to look forward to

"Did you sit up all night?"

"Goodness no! We reclined. We slept like a couple of tops. It was a wonderful trip."

"I must say you both look as fresh as a daisy."

"And we are. It's the most comfortable train I ever rode in. It's stainless steel, you know, and everything about it is so modern."

"Each seat has an individual light. I read 'til Jean was fast asleep and then joined our friends in the lounge."

"The dressing room was lovely. Large and with plenty of mirrors and places to put toilet articles. And good lights."

You, with millions of others, will be looking forward to a delightful vacation trip when war is over. The railroads will be ready to serve you then, just as they are meeting emergency war needs so magnificently now. There will be new trains everywhere—stainless steel streamliners, Budd-built—with new luxuries and conveniences. Many will be the popular one-class trains with reclining chair cars which are so comfortable yet so economical. Budd builds of stainless steel for strength and safety—builds entire trains, sleeping cars, dining cars, lounge and observation cars. Budd has created the most distinguished trains on America's foremost railroads.

EDWARD G. BUDD MANUFACTURING CO. • PHILADELPHIA • DETROIT Budd

Originators of stainless steel, lightweight trains, **ALLSTEEL*** *auto bodies and highway truck trailers. Designers and makers of airplane and marine structures. Inventors of the* **SHOTWELD*** *system of fabricating hi-tensile steel.*

*REG. U. S. PAT. OFF.

Two summers ago he was chasin' down cattle on a Texas ranch.

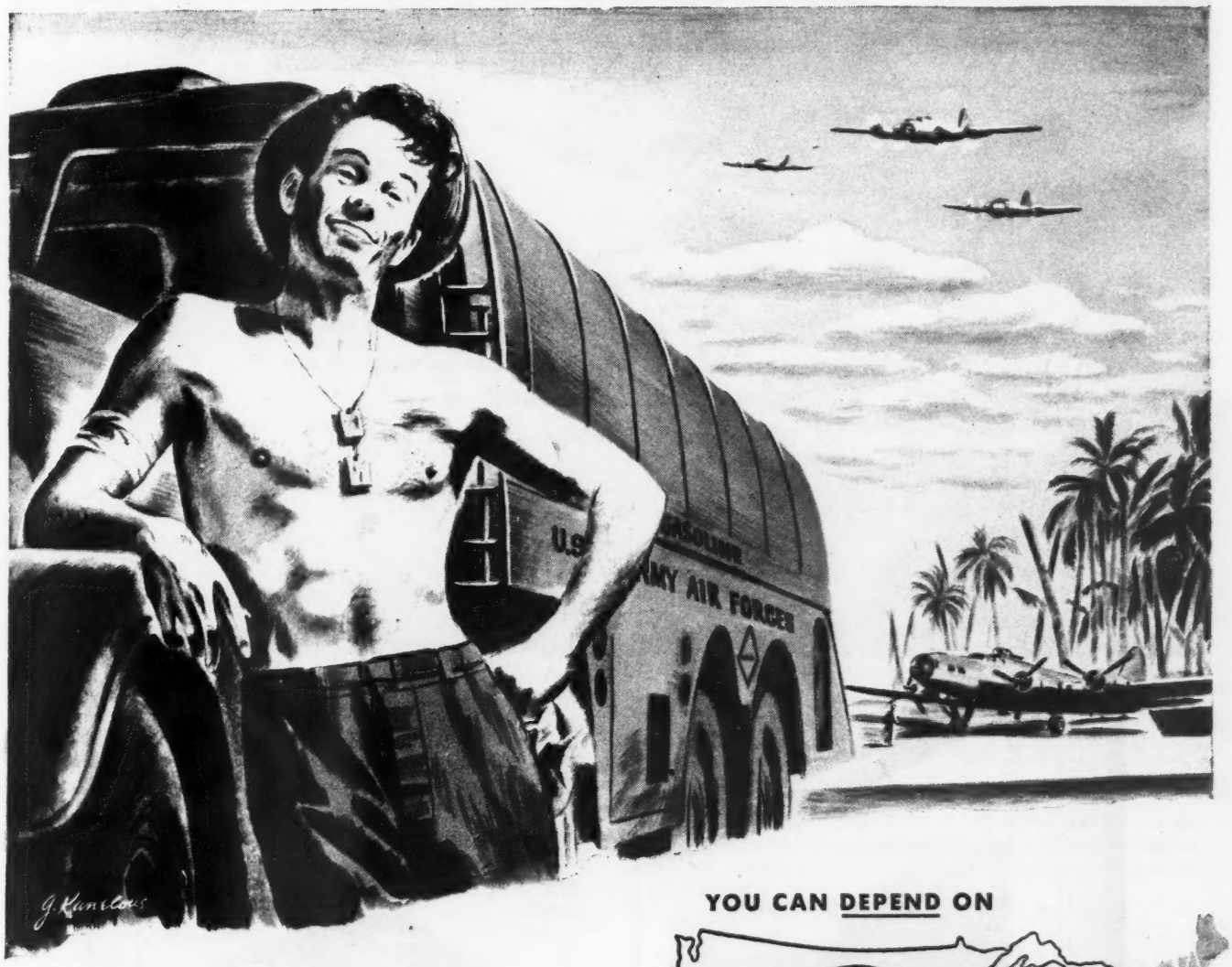
Now, in a truck he calls "Busy Lizzie," he hauls high-octane aviation gasoline round a jungle airfield. He's a key-man who knows every plane, pilot and crew-chief on the field.

All through the day and into the night he and his truck make their rounds, gassing up. And last thing, in the blackout of a jungle night, you can see the sparks his tail chain makes, dangling from the back of the truck, as it rattles across the steel-matted runway—still on the job.

Remember this cowboy and his truck of gasoline when you hear that American planes have destroyed yet another enemy target.

And remember him and the millions of his comrades *after* the war—men who have made *air travel, air cargo, air express* the business of their daily lives. And who will come home to make them safely, wonderfully and *surprisingly quickly* part of the daily life of their country.

Cowboy in a Cab...headed for tomorrow

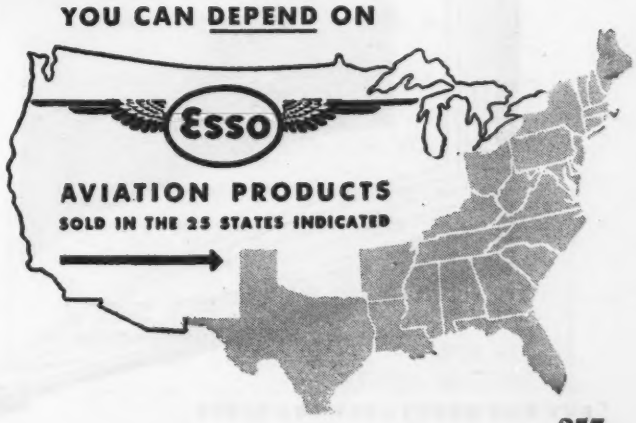


IT'S A GOOD BET *that the high-octane gasoline hauled by "Busy Lizzie" and her cowboy comes from the Esso refineries. Because every fourth combat plane in the Air Forces of the United States and Great Britain flies on gasoline from our refineries.*

With more than 40 years' practical experience in the manufacture of aviation petroleum products, together with a fund of new war-won knowledge and magnificent test-block and laboratory facilities, we will put extra power behind our promise that "You can depend on Esso Aviation Products."

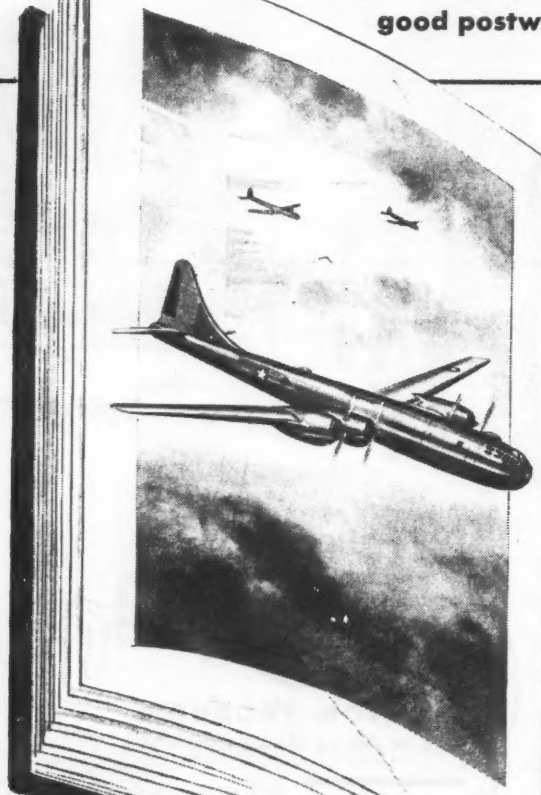
COLONIAL BEACON OIL COMPANY

YOU CAN DEPEND ON



EASY AS FALLING OFF A "LOG"

It's easy to "take" the tough ones when you've mastered your "log" tables. Learn to take 'em in your stride and you'll find the track wide open to a good postwar job in aviation.

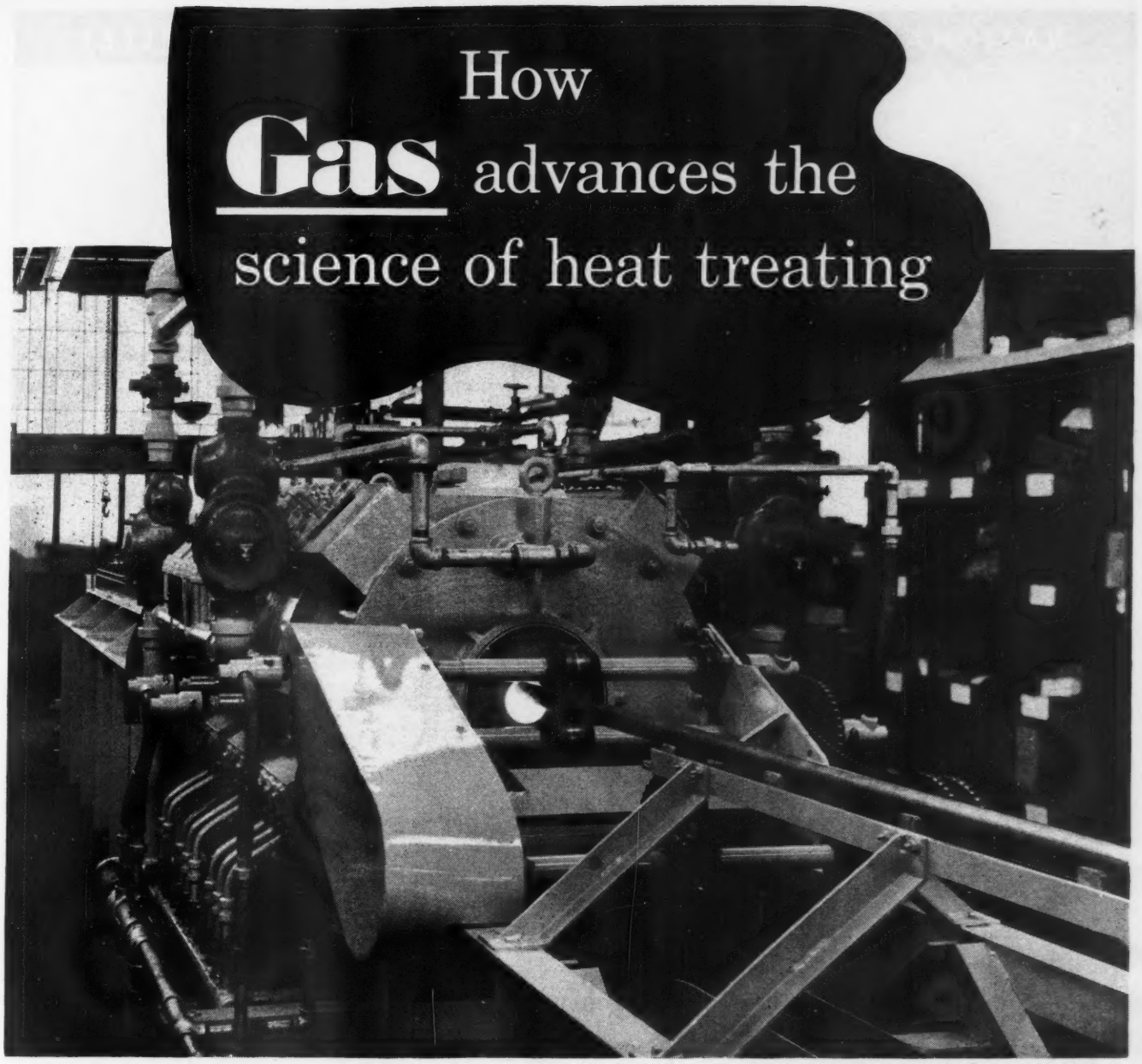


A leading producer of major components for the mighty Boeing B-29 Superfortress, Goodyear Aircraft Corporation also makes vital parts and assemblies for 15 other Army and Navy aircraft, including complete Corsairs and Navy airships. Goodyear, one of America's earliest pioneers in aeronautics, credits much of its past accomplishments to contributions made by youthful engineers, and will always have use for talented young Americans of solid character and scientific educational background.

GOODYEAR AIRCRAFT

GOODYEAR AIRCRAFT CORP., *Akron, Ohio*

How **Gas** advances the science of heat treating



Gas-fired rod annealing furnace; photo courtesy of Selas Corporation of America

Research in Gas application, through the ceaseless study and experiment of equipment manufacturers, independent laboratories and the facilities of the American Gas Association, is constantly producing improvements and new departures in the application of heat, industrially.

For example, heat treating of metal rods in batch furnaces has certain disadvantages, particularly that of uneven heating throughout the bundle of rods. A group of engineers recently perfected a continuous-flow type Gas-fired furnace with a ceramic heating unit capable of intense, focussed heat, and closely fitted to the shape of the work in progress.

There are many advantages to this new Gas technique for annealing. For instance, one inch rod stock passing through a six foot furnace of the new type can be heated and quenched at a rate of 12 feet per minute, no section of the metal remaining under heat more than thirty seconds—against 2½ hours in a batch furnace. Furthermore, better uniformity of heating is achieved; scaling, distortion, decarburization are minimized. Floor space of the new furnace is 24 square feet against several hundred feet for the older type. Over-all costs are also considerably reduced.

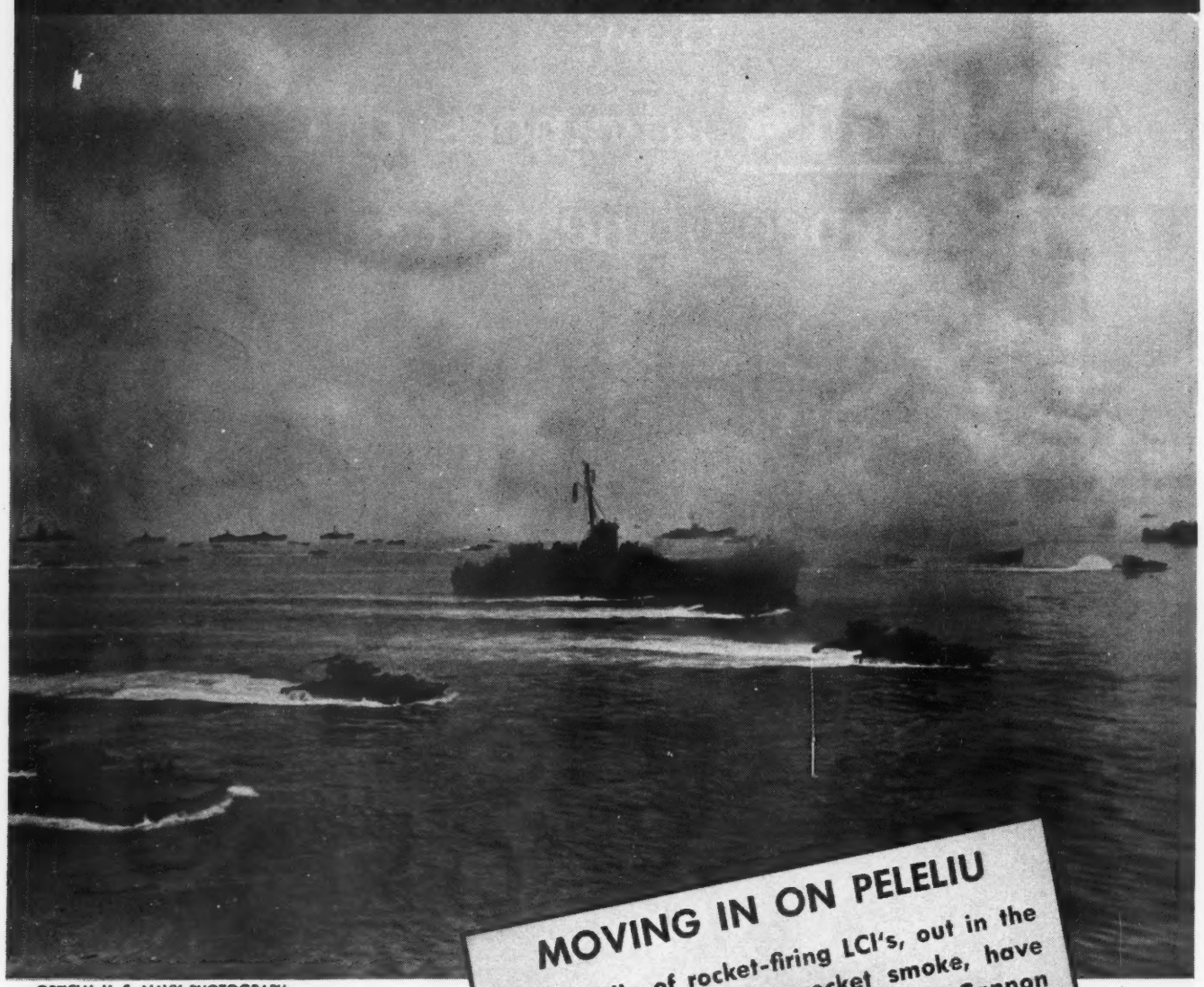
Local Gas Companies help make these new benefits of Gas and Gas Equipment available to industry through the services of skilled Industrial Gas Engineers, who are available for consultation without obligation.

BUY WAR BONDS—HELP SPEED VICTORY!

AMERICAN GAS ASSOCIATION
INDUSTRIAL AND COMMERCIAL GAS SECTION
420 LEXINGTON AVENUE, NEW YORK 17, N.Y.

THE TREND IS TO GAS
FOR ALL
INDUSTRIAL HEATING

NATIONAL RECEIVERS ARE THE EARS OF THE FLEET



OFFICIAL U. S. NAVY PHOTOGRAPH

MOVING IN ON PELELIU

A flotilla of rocket-firing LCI's, out in the foreground clouded in rocket smoke, have smothered the Jap beach defenses. Cannon firing "Alligator" tanks plow through calm water, to blast the way for assault troops. This is D-day on Peleliu, and the Americans have come to stay.

Three out of four of the Navy's ships — landing craft or larger — are equipped with receivers designed by National.

HRO

NC-200

NATIONAL COMPANY

MALDEN MASS, U. S. A.

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD

THE TECH ENGINEERING NEWS

PROFESSIONAL JOURNAL OF THE UNDERGRADUATES

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Volume XXVI, No. 9

MAY, 1945

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General Electric Company

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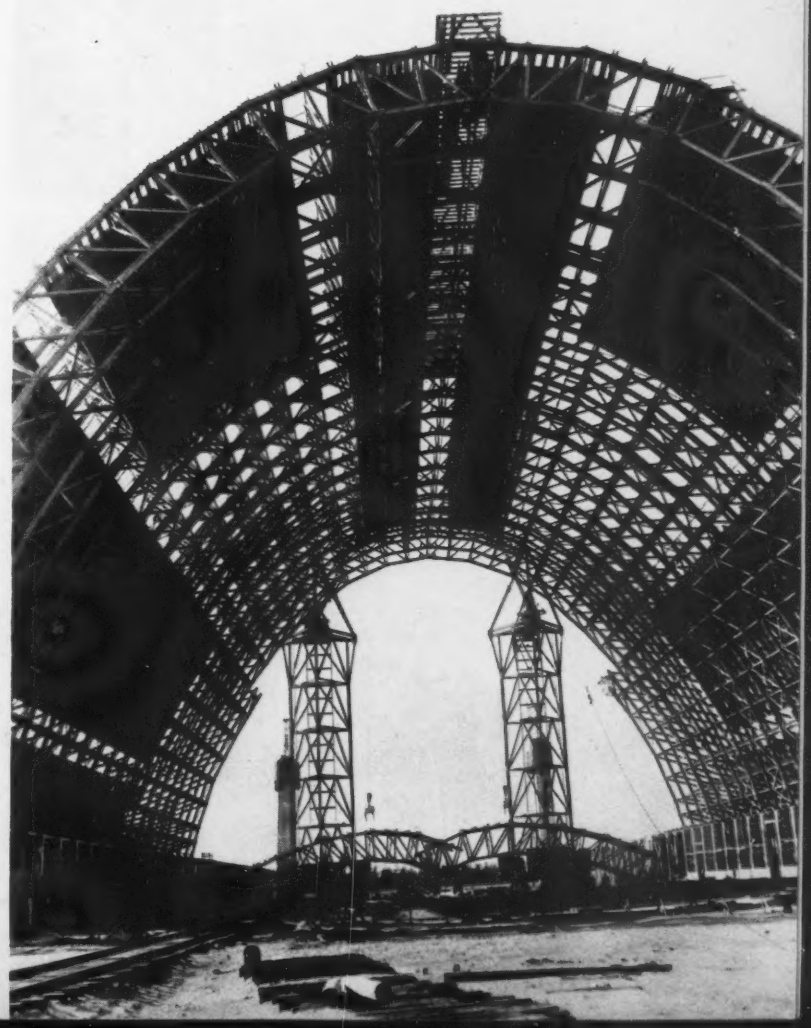
SOARING TIMBER ARCHES

Clear-spanning 237 feet, distinguish this world's largest blimp hangar now nearing completion for the United States Navy "somewhere in the continental U.S.A." The gigantic all-timber structure will be 1,000 feet long, 153 feet high. Says WPB: "Such a structure could not have been built of wood without the use of timber connectors." Timber was treated for fire resistance according to Federal specifications.



MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

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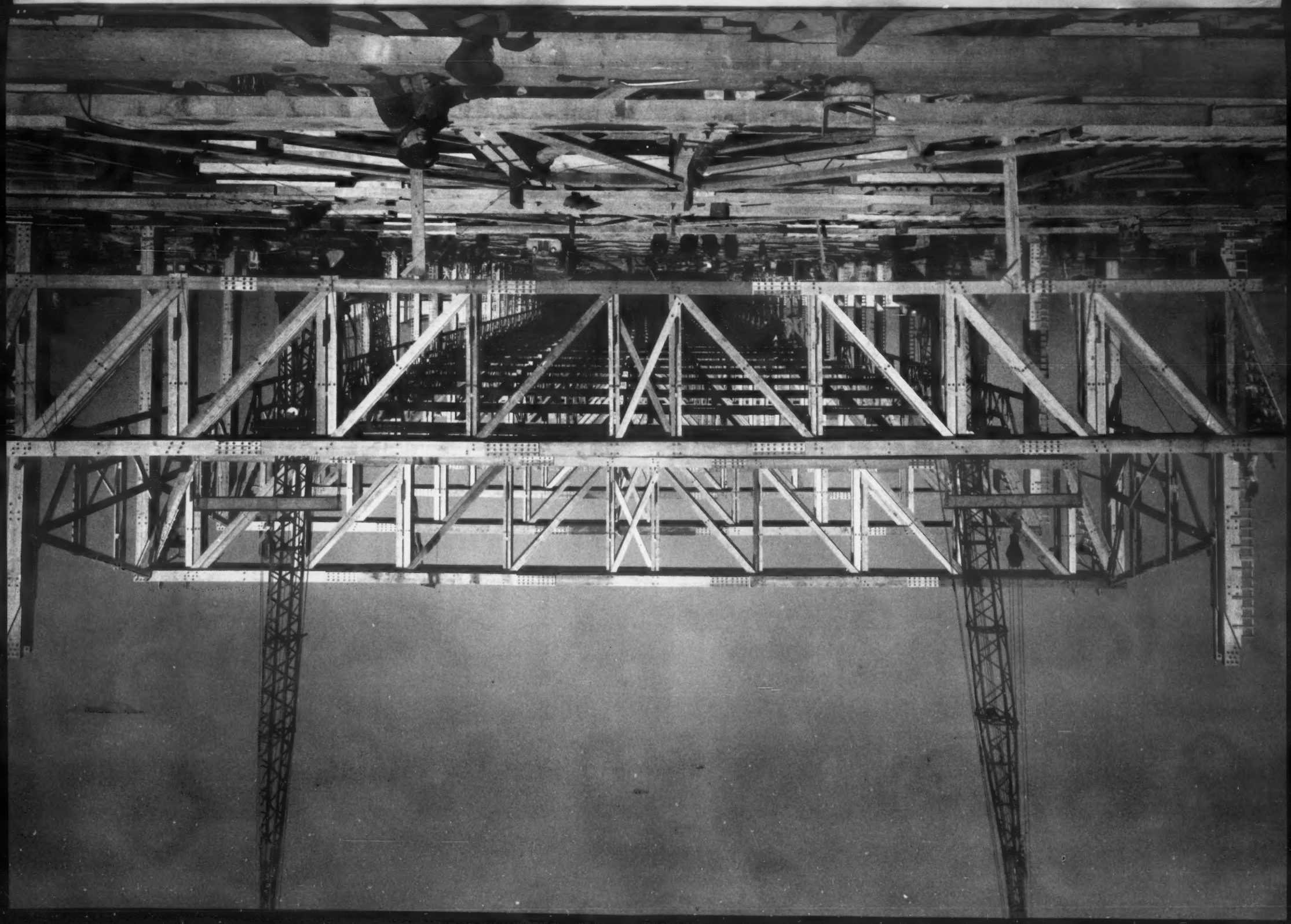


AIRPORT CONSTRUCTION

By MARVIN SWEENEY, JR., 2-47

IN the very near future an airport can either make or break a city. Air transportation is increasing and there is no reason at the present to believe that it will decrease in the future. Therefore, a city's growth or expansion lies in the success of its airport.

A city with a well planned and well maintained airport is bound to prosper. On the other hand, a city with a poor airport is doomed. This can be said for the small cities as well as the large. True, the small city cannot afford — and therefore cannot expect — the best in the way of airports. But if it expects to hold its place in the surrounding community, it should have some sort of an airport for feeder service.

The fact that all cities should have an airport does not make one. The finances and economics of the growing air industry will be the determining factors in airport development. Location is of the utmost importance, yet land cost and transportation between the port and the center of business must be considered. Mistakes in planning are costly, therefore postwar airports should be planned with future expansion in mind.

There have been numerous airports for military use built in the last few years. After the war many of these fields will be available for civilian use. But these will certainly not take care of all the air traffic in the future without rebuilding.

After the war we shall have the planes — all types of planes — we shall have the pilots for these planes, and we must have airports for them.

Airports of tomorrow will be of different types. The four most important ones will be those for passenger and mail transportation; for cargo, with facilities for gliders; for helicopters, and for private planes. For financial reasons these may be combined in their early development. Thus, possible change and expansion should be considered from the first. The amount of activity for each type will depend on the surrounding community — its industries, surface transportation, proximity to markets, etc.

Possibly the most important type of airport, so far as planning and maintenance is concerned, is the passenger airport. For here will be centered the activity that will hold the public interest. All the features for use, comfort and convenience of the passengers will be located here. Here, also will be maintained all the equipment and personnel to handle efficiently the many incoming and departing planes. As the airport develops, many of the behind-the-scenes activities will be transferred elsewhere, saving all the valuable space for passenger accommodations and office space for those using air transportation in their business.

Business centers along with hotels, theaters, restaurants, etc. will develop at the airport of large cities. In the past much valuable time was lost by the business man in travelling between the airport and the city. In the future, large companies will have branch offices at the airports, some may even have their main offices located there.

The recent accent on speed and the necessity of making maximum use of costly transport planes necessitates that the airport be designed, both in physical aspects and operating procedure, for quick and efficient handling of passengers, luggage, and mail. To facilitate such handling, special equipment will be used, such as walkie-talkie two-way radio sets, belt conveyors, fast, easily maneuvered derricks, two-level circulation for passengers, luggage, etc.

The relation of the airport site to the city is of primary importance. The business center and the airport must be more closely linked, so far as travelling time between the two is concerned. Without the proper solution to this phase of the problem, the airport's numerous other advantages will be nullified. Therefore, the design of the airport of tomorrow involves complete planning, from a regional plan covering the entire territory influenced by it, down to the most minute detail of the airport itself.

Adjacent to, and controlled from the main field will be a smaller field, for the use of helicopters, feeder lines and other planes authorized to land there. This field must be far enough away from the main field so its traffic will not interfere with that of the main field. It must be equipped with a system of traffic lights for the convenience of the planes that do not carry a two-way radio.

Rapid shuttle service must connect the two. Surface transportation will handle the heavier freight while passengers and mail will go by air. Therefore this field must also be equipped for fast and efficient handling of air cargo on the ground.

This adjacent field will play a large part in the success of the main field. All the traffic between the city and the main port will pass through here. Small planes, shuttling between the city and field will be analogous to the taxicab and trucking service between train stations in a large city.

In the coastal cities some provision must be made for handling the traffic of the transoceanic flying service. Since both land planes and flying boats will be used in this type of service, the main field must be designed to handle both types of planes, so that a passenger will be able to transfer from one to the other with a minimum loss of time.

The main field of the central airport will consist of a series of parallel runways, thus permitting several flights at the same time. These runways will be connected to the main apron, where docks for loading and unloading will be located, by a series of taxiways. This will leave the runways clear for landing and departing planes.

Traffic would be slowed if "empties" were left parked on the main apron, therefore a large parking area should be provided for them. These areas would not require hangars, although accommodations for crews that are waiting for their plane to be loaded or transferred to storage would be desirable. Facilities may be required for a quick general clean-up and service to those planes that will be going out on another flight. Flying equipment is expensive and it will be kept in as constant use as possible. The buildings at the passenger terminal will not only be planned for ease and efficient circulation of traffic, but will be designed to have dignity and beauty, which civic pride demands of

(*Continued on page 274*)

Raising a 150-foot truss at the world's largest timber factory building designed with a saving of 30,000 tons of critical materials. This plant will be operated by the Douglas Aircraft Company.

The Austin Company, Engineers and Builders

RESISTANCE WELDING

By DONALD DeWITT, 2-47

WELDING is a method of joining two or more pieces of metal together by means of the fusion or partial fusion of the metals. As the name implies, the heat which is used in resistance welding is supplied by a resistance to an electric current. In some cases, however, additional heat is supplied by an electric arc created at the point of fusion.

In this modern world, with the need for faster, more accurate and more economical production methods, resistance welding is gaining in importance over other types of welding. The advantages that resistance welding has over gas or arc welding are, speed, more accurate regulation of heat, lack of complicated metallurgy since no extraneous metals or fluxes are used, and the fact that the finished weld is almost exactly the same as the parent metal in its grain structure. Another great advantage of this process is that it can be used for practically all kinds or combinations of metals, and many alloys.

Although this method is best suited for mass production, it can easily be adapted to low production and job-shop work, and in either case the quality of the finished piece is high and the cost is relatively low.

The process itself is a simple one. The heat generated by a resistance to the current in a circuit varies with the resistance, the time during which the current is applied, and the square of the current. This can be expressed by the formula

$$H = I^2RTK$$

where K is a variable depending upon heat losses. Since the heat depends upon the square of the current, a welding transformer is used which steps down the voltage, and thereby increases the amperage.

The electrodes usually used are copper with tapered tips, the size of which depends upon the type of weld. Those used in ordinary spot welding have tips of small area, and offer little resistance to the current. By this means, a large intensity of current passes through them and little heat is lost through the electrodes. These electrodes are usually hollow so that they may be water-cooled.

The ordinary spot welding apparatus consists of two such electrodes, one of which can be moved by manual or air pressure, connected to a low voltage line. The two pieces to be joined are placed between the two electrodes and by means of heat and pressure a fusion between the two metals is made. The use of pressure in this process have both good and bad effects on the result. The forging effect tends to form a finer grain structure in the weld, and an increase in pressure makes low temperature welding possible. However an increase in pressure also increases the contact resistance and loses heat. The latter two results are compensating. Another factor which tends to reduce the effect of the pressure is the inducting reaction. The electrodes carry strong opposite charges amounting to ten thousand amperes or over. These tend to form a magnetic field which opposes the motion of the electrodes.

By the use of this method, all fairly high resistance metals can be welded to metals of the same or different material. The only metals which cannot be easily joined are silver, copper, and other good conductors. These can be welded using low resistance, high melting electrodes, but the process is done with the waste of a great deal of heat.

Since the heat applied also depends upon the time of current flow, cam and gear operated switches are used. These switches operate solenoid contactors which actually control the welding circuit. The major disadvantage of this method is that the contacts wear easily and the cost of maintenance is high.

In making spot welds it is practically impossible not to mark the surface. Although the weld is made, not on the outside surface, but where the two metals touch; and the actual fusion takes place not more than halfway through the thickness of the metal, the outside surface does become marked due to shrinkage of the metal. There are ways to minimize surface marking, however. These are by using a large area electrode, or using an electrode tip with a slightly convex shape.

The finished weld is a small oblate spheroid of fused metal containing part of the two pieces. In joining two fairly long pieces, when great strength is not required, these spot welds are placed three or four inches apart. When a portable spot welder is used it is moved along the length of the piece and the welds are made at the necessary distance. In a machine, the metal is drawn through the electrodes.

A variation of spot welding is seam or stitch welding. The electrodes on a seam welder are circularly shaped. When the welder is in operation the metal is placed between the two wheels and pressure is applied; then as the metal is drawn through, the welder welds a continuous seam which joins the two pieces together. Attached to the electrodes is an interrupter which continuously turns on and off the current. In this way the seam becomes a continuous line of spot welds. Seam welding is used in place of spot welding when either strength is required, or the product must be air- or water-tight. Seam welding is used for such things as gas tanks, pressure containers, and steam radiators. The spots vary from three to six or more per inch. Seam welding is sometimes done under water to keep the heating of the welding wheels down and thereby prevent distortion in the work.

Projection welding is a method of spot welding by which pieces of peculiar shape in places which are not easily accessible can be welded. At the spot where the piece is to be joined to another piece, a projection is stamped. This projection in the shape of a truncated cone is preferably made in the material while it is still being formed. When this projection is placed on another piece of metal, and heat is supplied, a weld will be made at the spot where the projection touches the other piece. By this method, although some heat may

(*Continued on page 276*)

Structural Performance of Wood Building in Wartime and Its Postwar Applications

By RICHARD CLEVELAND

Pictures Courtesy Timber Engineering Co.

WOOD! Wood! Wood for Army camps and cantonments, for war plants and war housing. More and more wood has been the demand from all parts of the country and from abroad. We shall see how this demand was met, and how the lessons learned in meeting it will find valuable application in the postwar world.

Wood, so long the universal building medium, has many desirable features which make it ideally suited for the uses to which it is put. It is the building material most acceptable for personal comfort, and for the most part is available locally. It is normally the least expensive material, and its records for speed in construction have not been equalled. Where the ordinary properties of wood are not usable, it can be treated by certain processes so as to render it virtually impervious to such abnormal conditions. Indeed there are few cases where wood will not serve as well if not better than any other material.

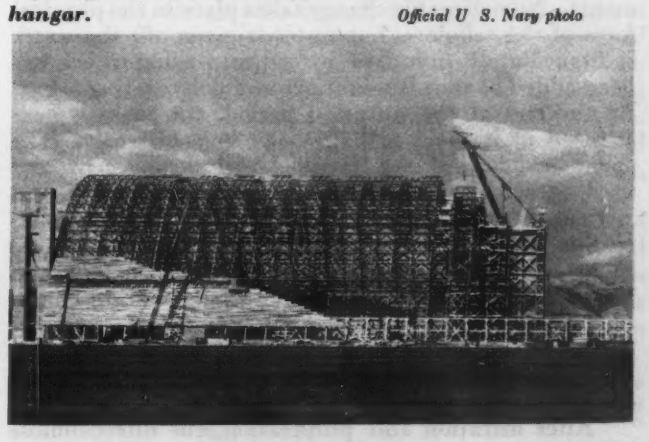
Prior to Pearl Harbor, we were vaguely conscious that a war was on, and that we might be drawn into it. Orders for foreign shipments of many types of supplies resulted in considerable building expansion, particularly in the industrial field, but the quantity of construction was minor compared with that which followed our declaration of war. As the momentum of our war effort increased, conditions changed. Facilities for multiplying many times our military forces and production of all the implements of war called for very rapid and enormous expansion in the buildings. Great quantities of all types of materials were needed for both production and construction. Before building got well under way, the use of metals was restricted largely to machines, and wood was called upon to do the lion's share of war building. At the same time, wood was being demanded in great quantities for thousands of items of wartime supplies and equipment.

Eventually the use of wood, the most plentiful and available of construction materials, also had to be controlled and conserved to render the maximum possible service in our war effort. Some idea of the desperate need for building lumber may be gained by considering the fact that in order to fulfill demands in certain parts of the country, lumber of all grades was bought at auction. This included a considerable quantity of No. 1, No. 2, and even No. 3 grades of non-structural lumber; *i.e.*, lumber which was not intended for use in structural member and therefore not graded for strength. This lumber was of the type used in housing and for similar purposes where appearance was the governing factor. In spite of the fact that this lumber in certain cases possessed only a fraction of the strength of the member specified in the designs, the designs were not altered. In addition to the wide use of non-structural seasoned wood, local conditions often required the use of green woods. This would have been allowable if the necessary compensations in design had been made, but here again the designs remained unaltered.

It is well worth remembering that the necessity for speed was an all important factor, and the inexperienced workmen who did the jobs inevitably made errors. Some of these were negligible, but there were cases of

(*Continued on page 280*)

Side view of naval blimp dock under construction. Note the crane rigged at the top of the interior traveling scaffold to set the upper arch sections of the hangar. *Official U S. Navy photo*



SOLUBLE NITROCELLULOSE

By HENRY L. LEE, JR., 2-47

SOLUBLE nitrocellulose became important industrially about twenty-five years ago. At that time, the expansion of the automobile industry created a demand for quick-drying finishes, adaptable to assembly-line manufacturing. Since then a variety of nitrocellulose finishes have been developed, creating a wide range of properties and uses.

Nitrocellulose is the ester formed when cellulose is treated with nitric acid. Cellulose has never been prepared synthetically, but is, instead, obtained from cotton linters and wood pulp. When cellulose is treated with an acid, one, two or three hydroxyl groups may be replaced by the anions of the acid, which, in this case, are nitrates. If cellulose is considered to be a trihydric alcohol, its empirical formula can be written as $[C_6H_7O_2(OH)_3]x$; and its reaction with nitric acid, under controlled conditions:

$$C_6H_7O_2(OH)_3+3HNO_3 \rightarrow C_6H_7O_2(NO_3)_3+3H_2O$$

The nitrogen content of cellulose trinitrate is 14.14 per cent. This percentage is not reached in actual practice; complete replacement of the hydroxyl groups is impossible from the practical standpoint, the upper limit being 13.8 per cent. The percentages suitable for commercial purposes, other than explosives, range from 10.5 to 12.2 per cent, while those used as munitions are above the latter value. The percentages below 12.2 per cent are referred to as soluble nitrocellulose.

Manufacture

Nitrocellulose is manufactured under carefully controlled conditions. Measured amounts of nitric acid, sulfuric acid, and cellulose are mixed together, the proportions of each being adjusted for a desired nitrogen content. The mixture is stirred for a predetermined time at a specific temperature. The data for temperature and the time period is derived from previous experiments. No noticeable change takes place in the physical form of the cellulose, but water is given off; the water is immediately absorbed by sulfuric acid, which has been added so that it might act as a dehydrating agent. At the end of the nitration period, the mass is centrifuged of its acid and drowned in cold water. The spent acid is captured, fortified with strong acid, and used again. The mass is drained of its cold water, and is treated with water having a certain pH. The mixture is boiled. The water treatment and boiling are repeated. The water has a specified pH in order to remove retained acid and to decompose and remove unstable products. During these treatments, samples are analyzed by the laboratory in order to determine when the product has reached the stability necessary for further processing.

After nitration and purification, the nitrocellulose has a very high viscosity. This high viscosity must be lowered, the exact amount depending upon the use for which the product is intended. The process by which the viscosity is lowered is known as digestion, and consists of superheating the product for varying lengths of time. The superheating is believed to shorten the chain-like units of the nitrocellulose by breaking the chains into shorter units. The result is a decrease in the internal resistance between the molecules, which causes the viscosity. After digestion, the product is separated from the accompanying water by means of pressure. The resulting blocks of cellulose are then wet with alcohol and are put through a block breaker, which loosens up the fibers so that they will be readily soluble in the compounding of lacquers, films, plastics, etc. The product is then packed in galvanized steel barrels, and additional alcohol is added. The product is of good stability, but excessive temperature, such as might come from a hot summer sun acting upon barrels that have been left exposed during shipment, causes a rapid increase in the rate of decomposition.

Lacquers

Large quantities of nitrocellulose are consumed by the lacquer industry. Nitrocellulose is used because of its high volatilization rate and because it can be made to have varying degrees of hardness, flexibility, and viscosity. Many tests have been made using different grades of nitrocellulose, and much material is available for study by the manufacturer. Viscosity has been the source of the most interest. Thousands of tests have been made in determining the ratio of nitrocellulose, solvent, diluent, and resin, in order to give a finished product with a pre-specified viscosity. Blending of two lacquers to give a third has been one means of attaining certain specifications of viscosity. Blending charts are in wide use and are entirely satisfactory within certain concentration limits.

The purpose for which a lacquer is intended is the controlling guide in its manufacture. The thickness of a coating of lacquer can be altered by changing the viscosity of the nitrocellulose. A lacquer that is too viscous will clog up spraying apparatus. A lacquer that is too thin will require an additional coating of the surface, resulting in an additional expenditure for labor. Lacquer that contains solvent and diluents that evaporate rapidly may sometimes dry to a chalky-white film. This is known as blushing, and is due to the precipitation of the nitrocellulose or other film-forming ingredients by water. Rapid evaporation causes cooling. Cooling causes condensation of moisture in the surrounding air. The moisture so formed collects on the surface of the drying lacquer and causes precipita-

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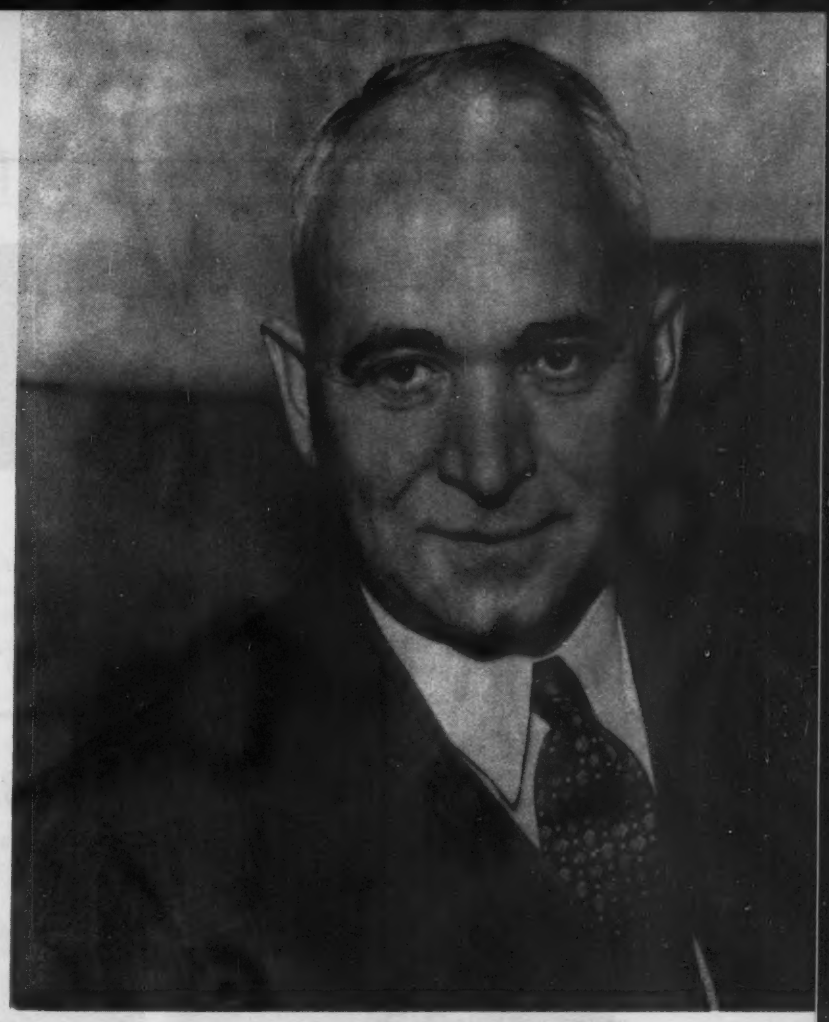
ALUMNUS OF THE MONTH



LAWRENCE H. FLETT
Director New Products Division
National Aniline Division
Allied Chemical and Dye Corporation

The distinguished American chemist, Lawrence H. Flett, was born on March 26, 1896. His parents were living in Melrose, Massachusetts, and it was there that he attended public school. After graduating from high school in 1914 he entered Massachusetts Institute of Technology with the intention of studying civil engineering, but under the influence of Professors Talbot, Phelan, Fay and Williams, and Dr. MacRae, he soon changed to chemistry. Later he specialized in organic chemistry under Professors Mulliken and Moore, and finally studied chemical engineering with Professor Warren K. Lewis. In 1918 the Institute awarded him a Bachelor of Science degree in Chemistry.

At that time the United States was at war with Germany, upon whom she had long depended for most of her dyes and intermediates, so that the country was in urgent need of commercial production of these necessary war materials. Mr. Flett's training ideally equipped him to take part in the effort to build up an American dyestuffs industry. It is not surprising therefore that he at once went to work as a research chemist at the Marcus Hook, Pennsylvania, plant of National Aniline and Chemical Co., dyestuff manufacturers.

In the midst of this endeavor peace was declared and there was much speculation as to whether the American dyestuff industry, or in a broader sense the American chemical industry, could survive the postwar competition with Europe.

After the war all research of the National Aniline and Chemical Co. was consolidated at Buffalo. In spite of the unfavorable outlook National Aniline, which was soon to become a division of Allied Chemical and Dye Corporation, undertook a twofold research program. First, if the American dyestuff companies were to remain in business they were faced with the immediate necessity of developing efficient commercial processes. Secondly, if the chemical industry was to survive there was the need for developing useful organic chemicals. Mr. Flett's immediate work was to put the azo dyes on a sound basis. The method of making these dyes was very largely revolutionized. Operating techniques introduced by him in those early years of the American dyestuffs industry are still being commercially practiced. When the work was complete there was available a line of products of better quality than had previously been imported.

By the time the depression of 1929 started this dyestuffs program was largely completed and the company was ready to expand the development of new products. A special group was gotten together for this purpose with Mr. Flett in charge. Among their accomplishments were many dyestuffs, intermediates, and even an entirely new class of dyestuffs.

Probably Mr. Flett's greatest achievement was the development of the first commercial synthetic detergent prepared from petroleum. Almost from the day petroleum was discovered in the United States a large number of chemists had sought in vain to prepare washing agents from it. Mr. Flett's product had a powerful washing action. It was stable in hard water and in neutral or acid solutions and was a very efficient dispersing agent under all conditions of service.

In recognition of his ability in industrial research, as exemplified by valuable contributions in the fields of dye intermediates, dyes and detergents, and in further recognition of his encouragement to the spirit of research in industry, the Western New York Section of the American Chemical Society awarded to him the Jacob F. Schoellkopf Medal in 1942.

About seventy-five patents in Canada, Germany, France, Switzerland, Argentina and the United States are held by him. These patents cover (1) detergents of the higher alkylarylsulphonate type, (2) applications of these detergents, (3) dyestuffs and intermediates and (4) miscellaneous materials. It is regretted that the confidential nature of patent applications filed in the Patent Office precludes any discussion of the unpatented uses. It may be stated, however, that some of his most important inventions in the detergent field have not been patented as yet. Among his miscellaneous patents is one on new means for combating parasitical fungi, molds and the like. This invention provides the medical profession with badly needed effective agents for curative treatment of athlete's foot, mange, and other more serious mycotic infections.

Early in 1944 in order to further the development of new chemicals as an aid to the American chemical industry, the National Aniline Division of Allied Chemical and Dye Corporation established the New Products Division and Mr. Flett was moved to New York from Buffalo to be its director.

His interests are many and varied. Mr. Flett is a member of the M. I. T. Club of New York, Downtown

(*Continued on page 276*)

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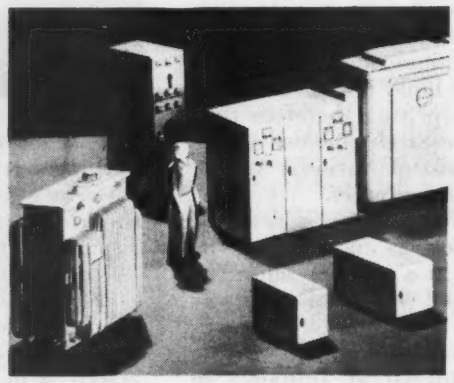

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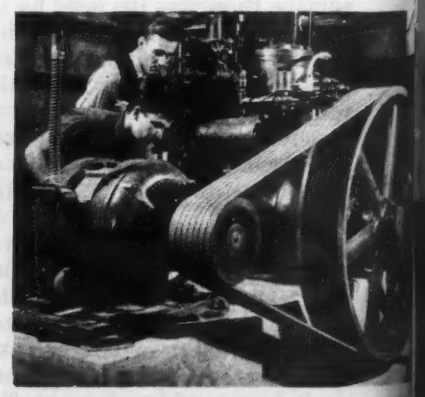

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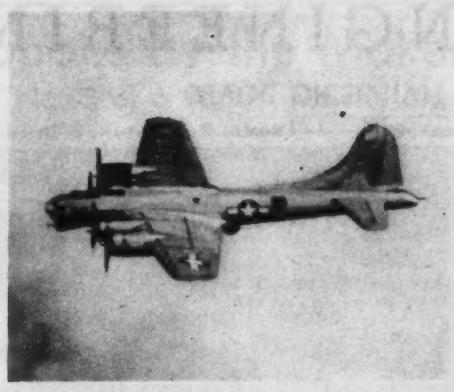

8 The ability of Allis-Chalmers to solve almost any kind of industrial problem was demonstrated two years ago when turbo-superchargers were urgently needed by the U. S. Army for bombers and fighters.

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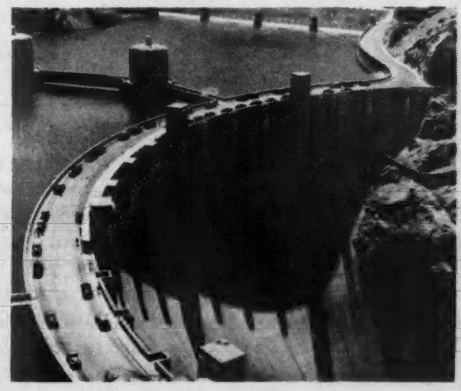

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PORT DEVELOPMENT . . .

An example and a challenge are presented to each individual community of the country by the postwar developments planned by Boston. We are here presenting an outline of what Boston is doing in the way of Port Development and ideas to other ports.

Waterborne transportation is the cheapest known, and for more than a hundred years men have built industries in New England by using the sea for transportation. The Port of Boston has long been the major gateway between New England and the sea. Major rail lines and highways to and from New England cities come together in the Port of Boston.

New England is a workshop. About one-half of the people are employed in industry and directly related occupations, and most of the industries must bring raw materials from distant sources. They must reship finished products to distant markets. In addition, they must transport from distant agricultural areas much of the food to sustain the industrial population. This industrial existence depends upon low cost transportation, and this means transportation by water, primarily through the Port of Boston.

Incoming shipment of just twelve selected commodities over low cost ocean highways through the Port of Boston saved Massachusetts $20,778,000 annually before the war. On canned goods from the West Coast via the Panama Canal, it saved $900,000 a year compared with transcontinental rail shipment. On lumber it saved $1,000,000. On sugar refined at waterfront refineries in Boston, it saved users throughout the State $1,250,000 annually.

Even more important are the savings in movement of raw materials to the industries upon which so many Massachusetts families depend for their livelihood. Ten industries, including wool manufacturing, cotton manufacturing, the sole and leather industry, the pulp and paper industry, employing more than two hundred thousand workers — one-third of all industrial workers in Massachusetts — need the Port for lowest cost transportation of their raw materials. If Massachusetts were to lose these industries, the effect on the New England economy would be catastrophic.

These industries face vigorous competition from other sections of the country. They must figure costs closely if they are to survive. A penny more in cost per unit may take a company from the black into the red.

As matters now stand, the Port of Boston will not be able, when final peace comes, to handle even the volume of cargoes which it handled before the war. Some old piers have been torn down. Many have been taken by the Federal Government and may not be available for handling commercial cargoes for several years after the war. At the war's end only nine berths will be immediately available to serve industry, agriculture and consumers, as compared with thirty-five berths before the war. Some of these nine berths are too obsolete to handle modern ships, which are one-third larger than prewar models.

Unless new piers are built, therefore, the Port of Boston will be a bottleneck. Goods will have to flow to and from New England industries by other and more expensive routes and means. Industries in New England will be handicapped in meeting competition from other areas. Some may not survive. Everyone who lives, works or does business in New England will be affected.

Therefore, Massachusetts has formed a committee for port development to compile information on expected postwar commerce through the port, to plan port development, and to secure financial resources for the project. As it now stands, two bills are before the Massachusetts Legislature providing for a minimum number of modern piers to meet the emergency, for a reorganized Port Authority, and for the appropriation of $15,000,000 by the issuance of bonds.

It can be seen, therefore, that Boston is laying a firm foundation in the postwar world both for its own commerce and for the commerce of most New England industries. We do not say that every community can lay a foundation as firm as that laid by Boston, but the residents of every community owe it to their community to see that all possible progressive steps that will aid the community are taken as soon as possible.

Electrical Weapons by the Maker of Bell Telephones

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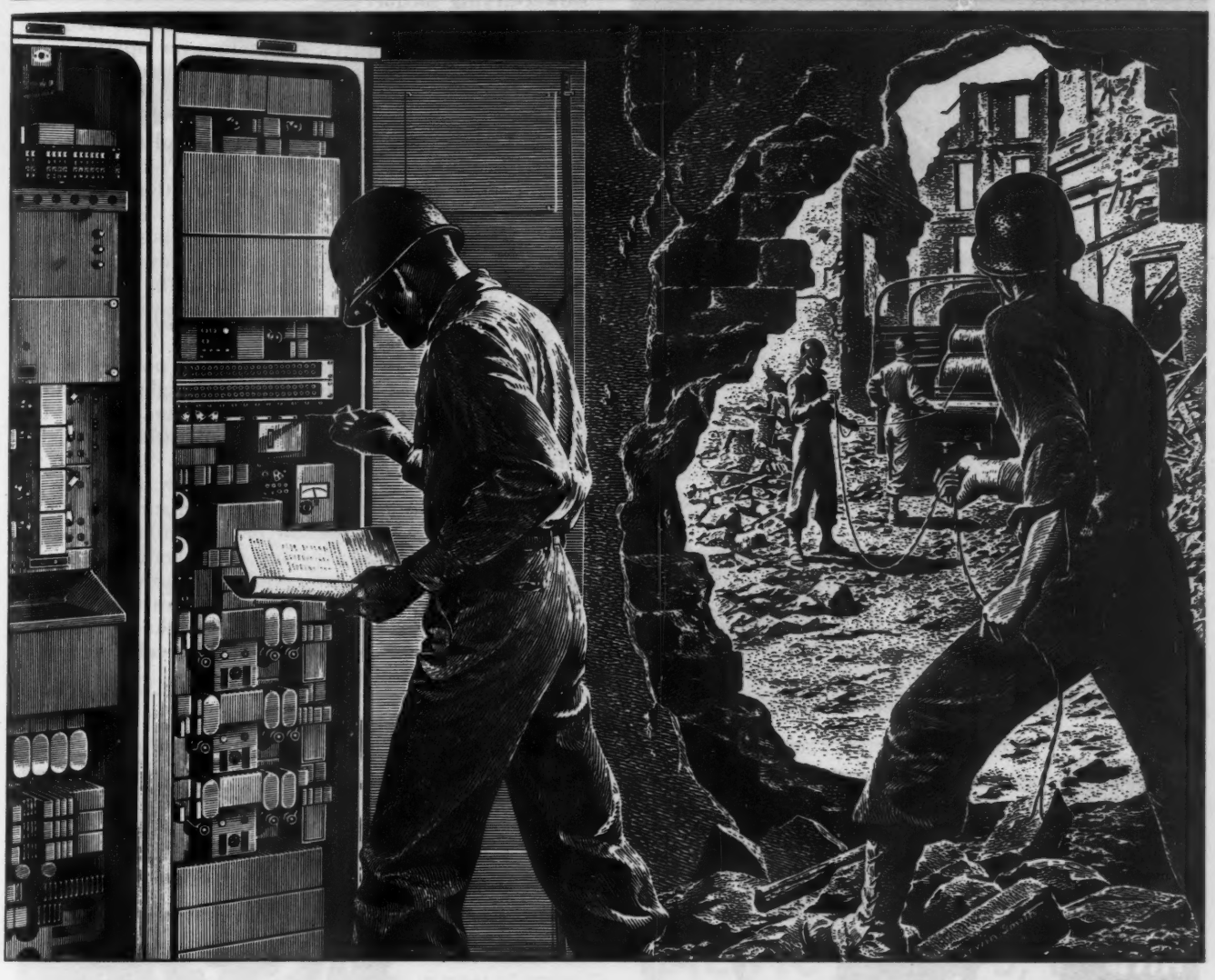

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SOLUBLE NITROCELLULOSE

(*Continued from page 266*)

tion of the nitrocellulose. Blushing is especially noticeable in moist climates, and may be avoided by using slower-drying lacquers.

It has been estimated that one half of the lacquers in use are clear lacquers, containing no opaque substances. The other half are pigmented lacquers, containing pigments of any hue or shade. Clear nitrocellulose lacquers are not particularly durable when exposed to the direct rays of the sun, and are thus not especially suitable for out-of-door use. Pigments, being opaque, shut out those rays of the sun that are harmful; and lacquer containing pigments is very durable. Pigments, besides imparting color, are chosen for their chemical inertness, good permanency, low oil absorption, soft texture, good tinting strength, and, where complete opacity is desired, good hiding power.

Plastics

Nitrocellulose has found its way into plastics, where it is characterized by its outstanding toughness, dimensional stability and low water adsorption. It has the disadvantages of flammability, discoloration by light, and degradation by high temperatures. Similar to its use in plastics, photographic emulsions are made of nitrocellulose. Amateur movie film is made of cellulose acetate, while in the motion picture industry, where constant usage is to be expected, and where smoothness of operation of film in projection machines is required, nitrocellulose film is used. The use of nitrocellulose in airplane dope, in adhesives, and in inks is a further example of the role which soluble nitrocellulose plays in our civilization of today.

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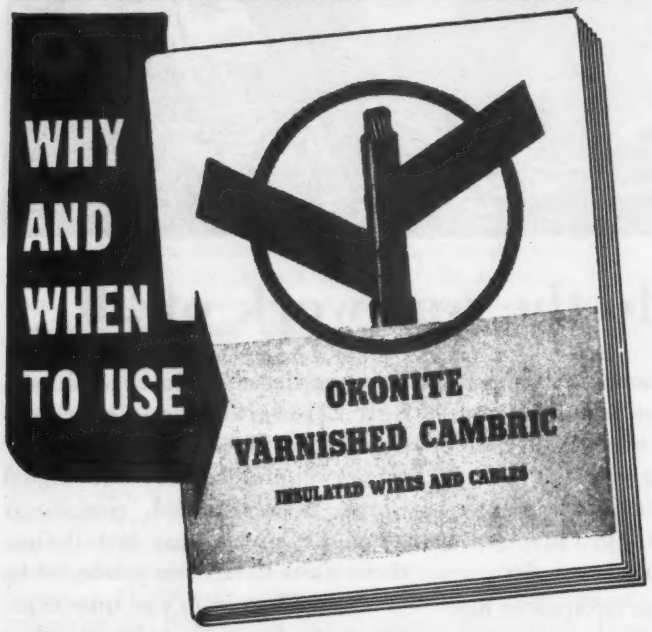

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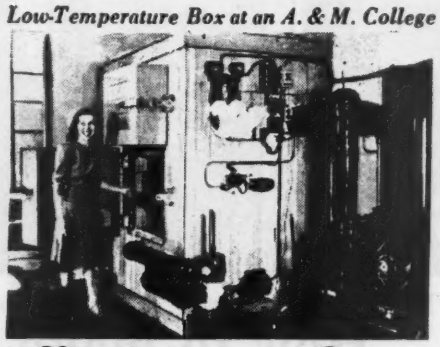

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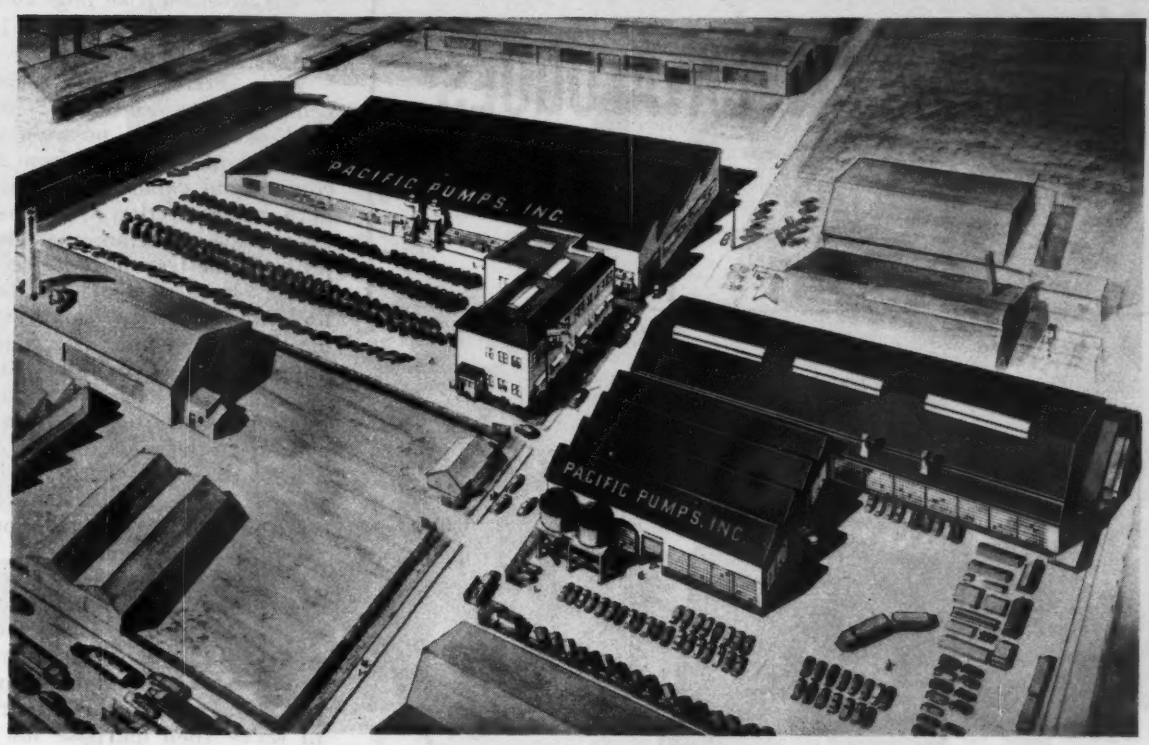

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HARRISBURG STEEL CORPORATION

Harrisburg, Pennsylvania

AIRPORT CONSTRUCTION

(*Continued from page 263*)

structures playing such an important part in community life.

With activity at the main field being devoted as nearly one hundred per cent as possible to the handling of the traffic from the incoming and departing planes many of the activities that in the past have taken place at the main terminal will probably be transferred to adjacent fields. Here will be located the building for servicing and maintaining the flying equipment, food preparation, flying personnel services, training, engineering and many of the other activities that are of no concern to the general public. These fields will not be so dependent on transportation facilities, as the general public will have little or nothing to do with them.

Buildings at the service field may be of light design, with great spans and clear areas. These buildings will not be designed as monuments or impressive community buildings, but rather as expendable structures to serve their purpose for only a short while. Air transportation is developing so rapidly that no one can predict the needs and services of these fields for more than a few years ahead. Consequently, the structures for these fields should be designed for maximum efficiency during the immediate period, with a minimum of loss when changes demand an alteration or movement.

Hangars for the maintenance of planes will be of sufficient size to house the planes as we know them today. However, when planes reach the height and wing spread of the giants being tested, it is doubtful if it will be economically feasible to build structures that will completely house these super planes. Instead large cantilever constructions will protect the men servicing the plane in the open — as ships are handled in dry-dock. Parts of the plane which cannot be worked on from the interior will be designed for easy removal, thus they can be detached and taken to a suitable place for service.

These airports of the future are going to be much more complicated than the airports of today. They must be constructed with efficiency, accessibility, and comfort in mind.

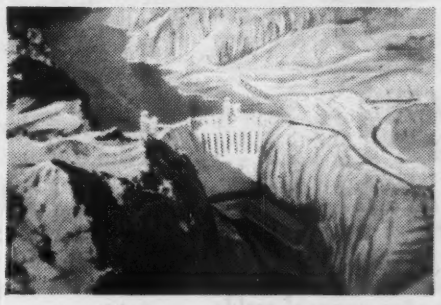
Men must be specially trained, if these airports are going to be successful, in their design and construction. Consequently, in the near future a new field in architecture and engineering will be opened — Airport Design and Construction.

COMING YOUR WAY

A New Kind of Horsepower is Changing Your World

This is the story of what is likely the biggest thing that has happened in our time . . . of a new kind of power spreading throughout the world . . . of a new force affecting our lives, our outlooks, and our incomes as perhaps only electricity has done since the turn of the century.

1. Under the wing of a giant Lockheed Constellation, in the shadow of one of the big ship's four Wright Cyclones, two men talk. One is a veteran airline pilot who lives and works in a world most people haven't yet begun to know or understand or even to imagine! The other, a man who has seen a whole vast western section of America change in his lifetime as if by magic!



2. The Westerner operates a ranch that was literally made possible by power — electricity and irrigation from the great Boulder Dam harnessing the Colorado River. Power which made possible the conversion of millions of acres of barren wilderness into fertile ranches and farms!

3. No wonder he's eager to hear the pilot tell of a new super-power — such as that of the Wright Cyclone . . . the engine which speeds the great Boeing B-29 Superfortress across the air miles to Tokyo . . . power that makes possible a trans-Atlantic flight every 13 minutes.

4. Most efficient power plant in the world, today's Wright Cyclone packs a horsepower into less than a pound of metal. Four Cyclones develop more power than the mightiest locomotive operating in the Rocky Mountains . . . and already this new power is changing ranches and farms, business and homes . . .

5. These Cyclones help make possible the operation of U. S. transport planes over more than 110,000 miles of global air routes. For example, 1,800 cargo shipments daily leave a single U. S. airport, and millions of miles are daily flown by U. S. airlines and the Air Commands of our armed services.

6. Carrying our men, materials, ideals to the corners of the earth — breaking down barriers of distance — the Cyclone power of American aviation is changing the world you live in...right over your head!

LOOK TO THE SKY, AMERICA!

CURTISS WRIGHT

AIRPLANES • ENGINES • PROPELLERS

[AVIATION OFFERS A BRIGHT FUTURE FOR COLLEGE ENGINEERS: WRITE ENGINEERING PERSONNEL BUREAU, CURTISS-WRIGHT CORPORATION, PASSAIC, N. J.]

RESISTANCE WELDING

(*Continued from page 264*)

be wasted, a weld can be made at practically any point which could not easily be made by ordinary spot welding means. Other advantages of this method are that large area electrodes are used and thereby the cost of electrode maintenance is reduced. By using several projections in the area of the electrodes, several welds can be made at once. The location of the weld, and its size, can be much more easily controlled, and surface contact conditions are much more certain than in ordinary spot welding.

Another type of resistance welding which is widely used is butt welding. There are two types, upset and flash. In the first process the two pieces are butted, that is, they are placed end to end, and the proper amount of pressure is applied so that they will be in the correct alignment. The current is then applied through large area electrodes which are clamped to the pieces. When the proper welding temperature is reached the pressure upsets or forges the parts together. Materials with a very short plastic range such as copper or aluminum are easily upset butt welded by the push-up method. The major disadvantage of this method is that if the proper temperature is exceeded, the metal melts and slumps off instead of welding. Upset butt welding is used principally on non-ferrous materials for such processes as joining lengths of extruded wire and tubing. The electrodes are made in the form of clamps or jaws, and must be large enough to introduce a large current without creating a hot spot and welding itself to the material. A recent development has been a method of welding copper terminals to an aluminum coil. By decreasing the pressure during the heating period, and increasing it in the push-up period, the brittle eutectic alloy which is usually formed when aluminum is welded is squeezed out, and the results are quite satisfactory.

Flash butt welding, however, is much more frequently used than upset. In this process the metals are clamped to the contacts as in upset, but the voltage is applied before the pieces are butted together. As the pieces touch each other, an arc is formed which burns away part of the metal from each side. When the welding temperature is reached, the materials are drawn together, and the power is turned off as they are upset.

Of all the processes which have been discussed, flash butt is the only process where the greater part of the heat is not obtained from a resistance to the current. The arc between the pieces supplies practically all the fusion heat, and some is supplied by the combustion of the work surfaces. The advantages of flash butt over other types of welding are: less power is required to make the weld, since the arc creates more heat with a given current; and the two surfaces which are joined are clean, since some of the metal is burned away.

There are special welding methods or techniques which can be applied to butt or spot welding if the circumstances call for them. Pulsation welding is a method of making a cleaner, stronger weld, and at the same time its use keeps the equipment in better shape. As the name implies, the current is sent through the material, not in a steady flow, but in short spurts or pulses. During the time when the current is off, the heat spreads, and the weld is made more evenly over a large area. The "off" periods also make the water cooling in the electrodes more effective. This method is used for the most part in butt and multiple projection welding.

A type of butt welding, used in joining wires and small diameter rods, is percussion welding. This is a method of flash butt welding in which the source of power is a capacitor. At the time the weld is to be made, the two parts are propelled toward each other, then the current which has been stored up, is released, and an arc is created. The impact of the two pieces causes the forging action. The greatest disadvantage of this process, is that the size of the weld is limited to one-half square inch, and that the voltage required is very high.

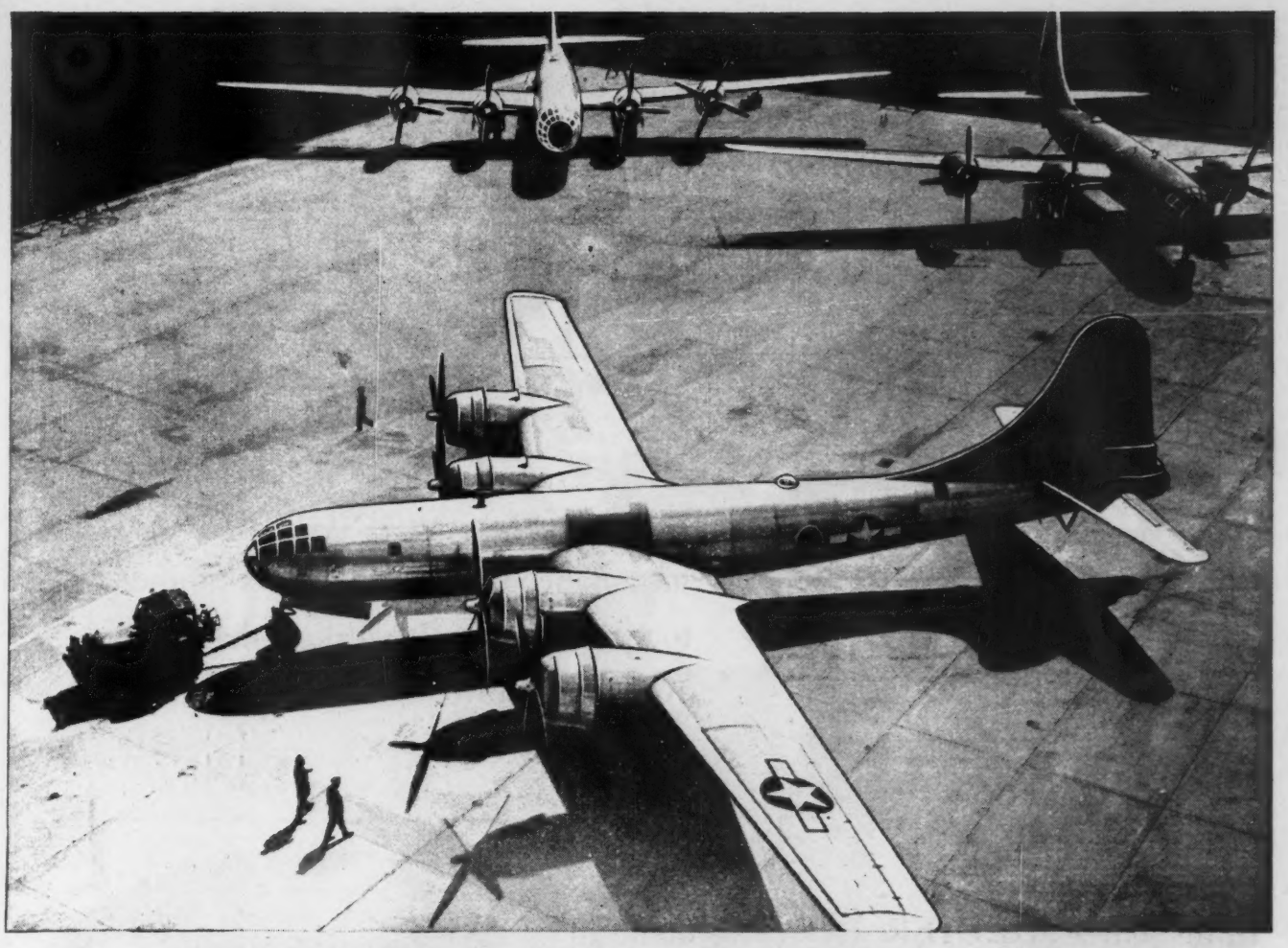
There are uses for welding equipment other than welding itself, such as burning holes in hardened metal parts, annealing, brazing and soldering, the latter two of which are in a sense non-pressure welding, but these are minor applications of a great and expanding process.

ALUMNUS OF THE MONTH

(*Continued from page 267*)

Athletic Club, American Chemical Society, Society of Chemical Industry, fellow of the American Institute of Chemists, and a member of numerous other professional and social organizations. He has also written an article on dyes for the T.E.N. (See "The Colors," Vol. XXVI, No. 2, October, 1944.)

It was once said of this finely molded research chemist by an associate of many years, "To the most routine and simple jobs he always brought a fresh point of view, a speculation as to whether there might not be a new and better way of doing the old, old jobs and an enthusiastic program of investigation of what to most of us would seem merely old and dull stuff."

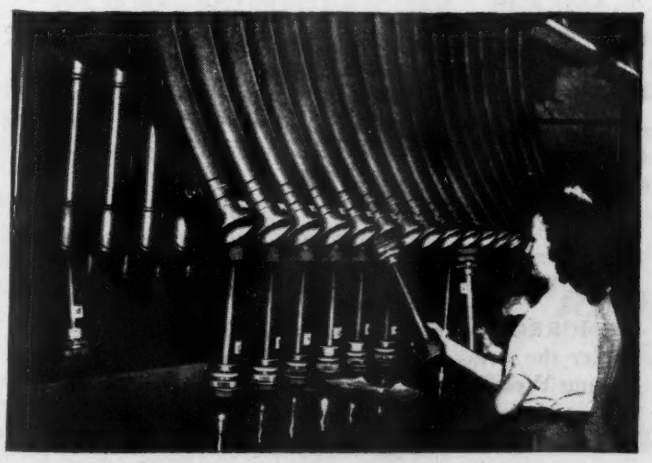


LAMSON PNEUMATIC TUBES

help hurl more Bell-Built Superforts Against the Enemy!

The Georgia Division plant of Bell Aircraft Corporation is designed on a scale to stagger the imagination. A main building nearly a half-mile long! —nearly a quarter of a mile wide! A paint shop larger than many complete industries! Hangars almost 900 feet long! Vast distances between buildings!

The WRITTEN records necessary to run this tremendous plant must always be available. Responsibility must be accurately determined. To handle the terrific flow of reports, blueprints, memoranda, and orders—to move them speedily, safely—free from prying eyes—Lamson Engineers installed a 12-mile network of pneumatic tubes. Secrecy is so important that each of the 48 receiving stations is equipped with a lock—which can be opened only by one with authority to handle the papers within. A signal light indicates important documents awaiting removal!



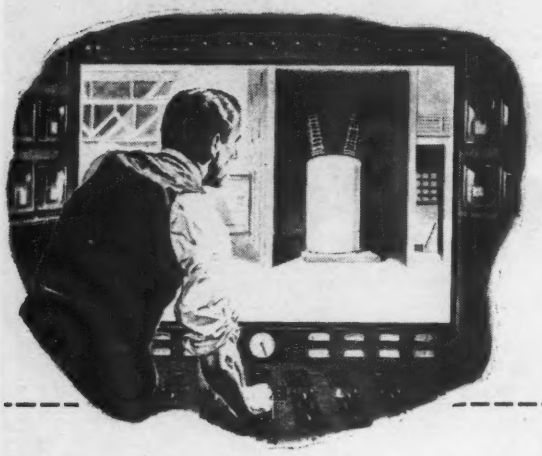
We've prepared a booklet called "THE WINGS OF BUSINESS"—telling you how these mechanical messengers can cut cost and speed the flow of business in plants, stores and offices. A postcard will bring your copy. Ask for it today!

← Operators of this central tube desk receive and dispatch carriers to all parts of the huge plant.

LAMSON CORPORATION
950 Lamson St., Syracuse 1, N. Y.

In a field hospital, a SURGEON uses a new x-ray machine that marks the exact location of the bullet, speeds life-saving behind the battle line.

. . . the name on the X-RAY MACHINE is Westinghouse.



In a laboratory an ENGINEER uses the instantaneous power of 75,000 thunderbolts to test giant circuit breakers that protect America's power systems.

. . . the name on the CIRCUIT BREAKER is Westinghouse.

In his tent a SOLDIER uses a bug bomb to destroy insect life – safeguarding health and increasing comfort in tropical jungles.

. . . the name on the BUG BOMB is Westinghouse.

In a war plant a WORKER uses an electromagnetic device to detect flaws in heat-treated bearing races – keeping our combat vehicles rolling on to victory.

. . . the name on the ELECTROMAGNETIC DEVICE is Westinghouse.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

TODAY—Westinghouse products are serving in every battle, on every front, in the war against aggression.

TOMORROW—New processes and new materials . . . created under the stress of war . . . will mean better and longer-lasting Westinghouse products for a world at peace.

Tune in: JOHN CHARLES THOMAS—Sunday 2:30 pm, EWT, NBC. *TED MALONE—Mon. Tues. Wed. Evening, Blue Network*

RCA Laboratories model with an 18 by 24-inch screen showing how Bob Hope may appear on future home television.

New Projection Television - Bob Hope's face "big as life"

Can you picture Bob Hope on television . . . seeing his face *big as life*—right in your own living room?

Well, you will—for now, thanks to RCA research, all limitations on the size of home television screens have been removed.

RCA Projection Television sets can have 18 by 24-inch pictures, or for that matter, pictures as large as the screen in a "movie" theater!

When you tune in an NBC television broadcast you'll almost think the actors are in the same room with you—and trust NBC, America's No. 1 network in sound broadcasting, to bring you the best in television entertainment.

This revolutionary improvement was achieved in RCA Laboratories by development of an entirely new reflector and lens, shown in phantom above. This lens, of inexpensive plastic, is 8 times as efficient for the purpose as the finest optical lens.

When you buy an RCA radio, phonograph or television receiver—or any other RCA product—you receive the benefit of the latest research development of RCA Laboratories. It is this *plus value* which is your assurance of lasting satisfaction.

The widespread public recognition of this plus value has given to RCA world leadership in the radio, phonograph, television and electronic art.

Dr. D. W. Epstein with a projection television tube, reflector and lens unit. Here the image on the end of the tube hits the reflector, is corrected by the lens, projected to the screen, then enlarged . . . making possible larger and clearer television than ever before.

RADIO CORPORATION of AMERICA

PIONEERS IN PROGRESS

RCA

Roebling produces every major type of wire and wire product . . . toaster cord to telephone cable . . . bridge cable to wire rope . . . fine filter cloth to heavy grading screen . . . strip steel and flat wire to round and shaped wire . . . all Roebling products. *All* the result of over 100 years of wire specialization.
John A. Roebling's Sons Company, Trenton 2, N.J.

JR ROEBLING

ROEBLING

PACEMAKER IN WIRE PRODUCTS

WIRE ROPE AND STRAND • FITTINGS • SLINGS • SUSPENSION BRIDGES AND CABLES
COLD ROLLED STRIP • HIGH AND LOW CARBON ACID AND BASIC OPEN HEARTH STEELS
AIRCORD, SWAGED TERMINALS AND ASSEMBLIES • AERIAL WIRE ROPE SYSTEMS • ROUND
AND SHAPED WIRE • ELECTRICAL WIRES AND CABLES • WIRE CLOTH AND NETTING

STRUCTURAL PERFORMANCE

(*Continued from page 265*)

a very important nature. An example of this occurred in a large industrial building where parallel chord Warren trusses of considerable span were used in the roof system. After all of the sheathing was in place, an inspection revealed that the members were installed in such a way as to reverse the stresses in the members under load.

Although a great number of large wartime wooden buildings were built under these adverse conditions, there are few instances of actual collapse of roof trusses. Frequently, the mistakes were discovered and corrected before mishaps occurred.

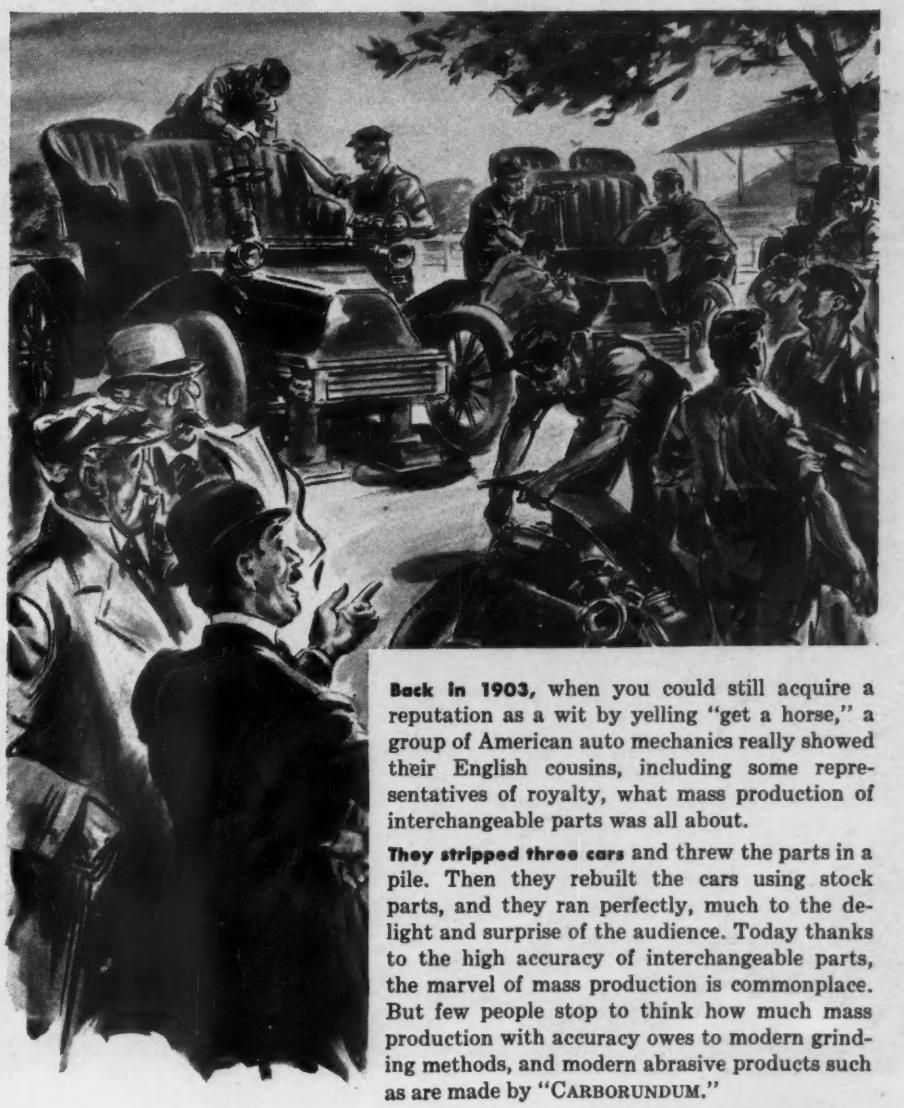
The Army, realizing that wartime construction standards were far below those of peacetime, ordered an inspection of all its installations in this hemisphere. They comprised about one and a quarter billion square feet of floor space, yet there were only nine cases reported where roof trusses actually collapsed.

The practically unanimous reactions of engineers who inspected the wartime timber structures was amazement at the few failures which did occur. They also agreed that stress design in use prior to the war for stress grade lumber was far too conservative, and therefore uneconomical for timber buildings properly designed and constructed.

As a result of these findings, there was released in December of 1944, the *National Design Specifications for Stress Grade Lumber and Its Fastenings*, which represented a decided increase of the rated strengths of stress grade lumber. Widespread experiments and laboratory test were conducted to confirm the validity of these specifications. It was assumed in compiling the specifications that correct designs and construction would be used. It is expected that these revised standards will be widely used in the postwar world.

Throughout the course of the war, increased limitations on the use of steel and other metals has inspired scientists to even greater efforts along the lines of improving the durability and structural properties of wood. Particularly important among these developments have been the discovery of new glues which are impervious to atmospheric conditions and are as strong as the wood itself. The logical extension of wood to even greater use in maritime, vehicular, and structural fields will follow in the postwar world.

The grease monkeys that tickled Royalty!



Back in 1903, when you could still acquire a reputation as a wit by yelling "get a horse," a group of American auto mechanics really showed their English cousins, including some representatives of royalty, what mass production of interchangeable parts was all about.

They stripped three cars and threw the parts in a pile. Then they rebuilt the cars using stock parts, and they ran perfectly, much to the delight and surprise of the audience. Today thanks to the high accuracy of interchangeable parts, the marvel of mass production is commonplace. But few people stop to think how much mass production with accuracy owes to modern grinding methods, and modern abrasive products such as are made by "CARBORUNDUM."

Helping industry increase production and lower costs is one of the most satisfying of occupations. And that is the job of "CARBORUNDUM" Abrasive Engineers. If you would like to consider this form of engineering for your life work, please write The Carborundum Company, Niagara Falls, New York.

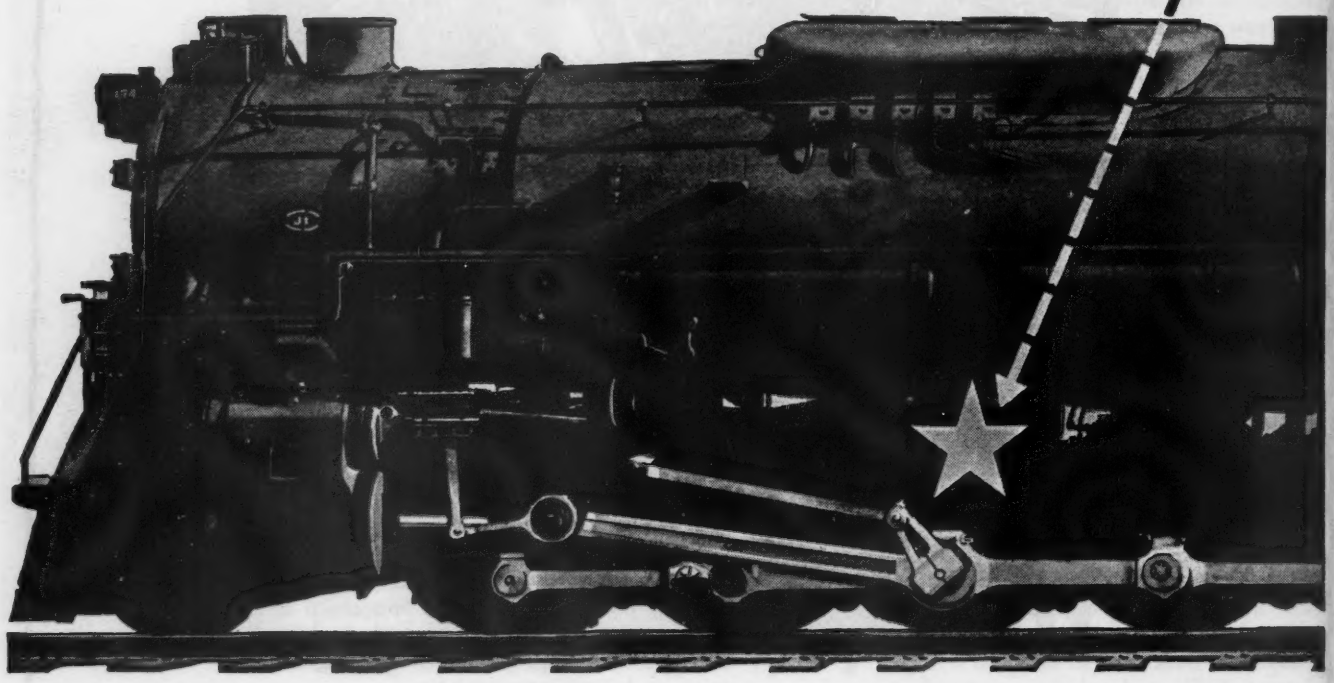
PRODUCTS BY

CARBORUNDUM

HELP YOU MAKE THINGS BETTER
IN INDUSTRY, AGRICULTURE, ARTS AND CRAFTS

("CARBORUNDUM" is a registered trade mark of and indicates manufacture by The Carborundum Company)

SKF
Puts the RIGHT BEARING in the RIGHT PLACE



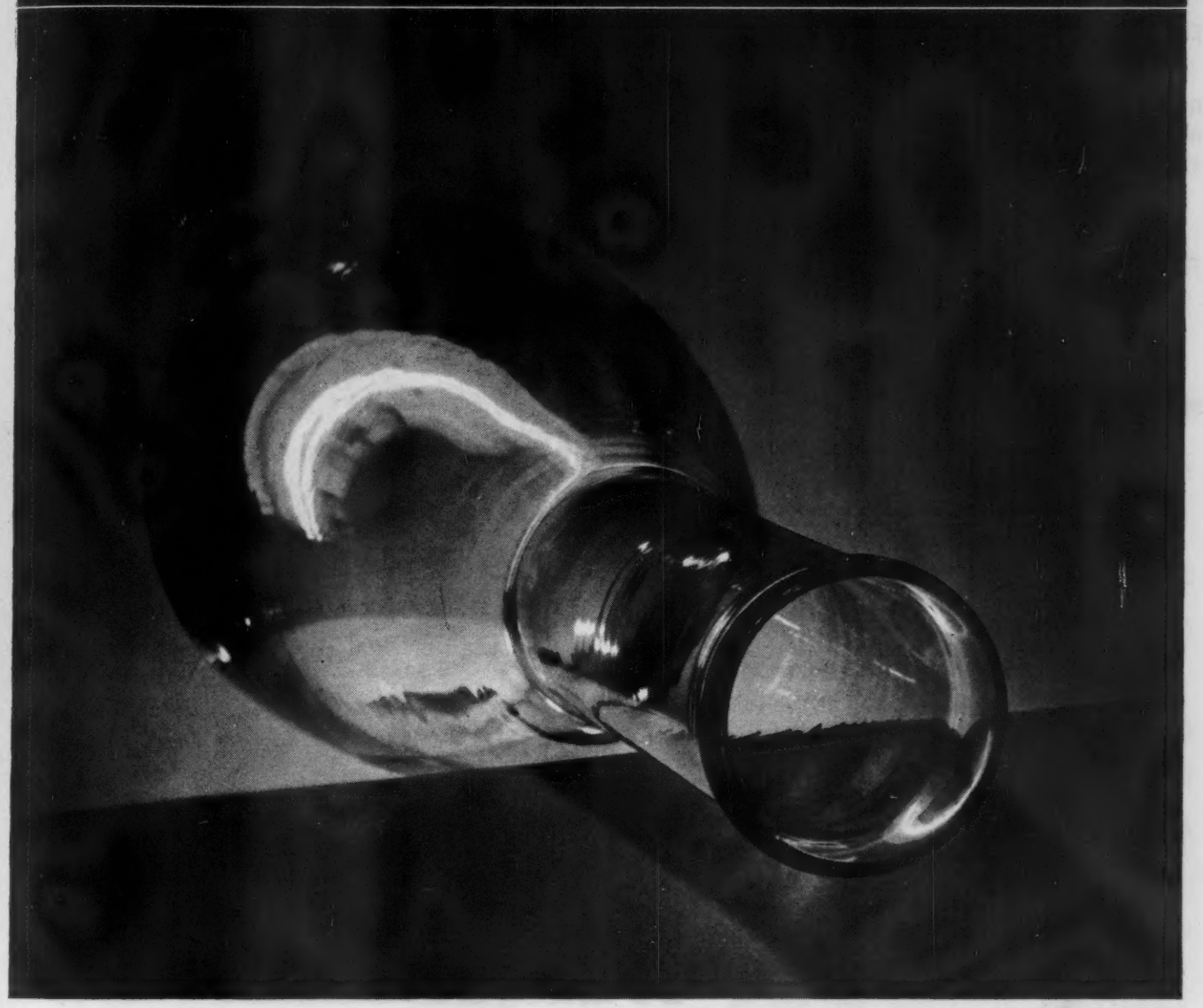
For every application where a bearing is needed . . . whether for the vital rotating parts of a powerful modern locomotive or the comparatively simple requirements of a motorcycle . . . there is *one* type and size of bearing that will do the job *right*. Anything else is a substitution—not quite so efficient.

That's why SKF makes a *complete* line of both ball and roller bearings. True, in wartime, you have not always been able to obtain the SKF bearings you needed. That was because our armed forces have demanded so much of our production that even a six-times increase in capacity couldn't meet all the heavy military and civilian requirements.

Some day — fairly soon, we hope — SKF and its distributors will again be able to offer you prompt service on a complete line. SKF makes practically all types of anti-friction bearings. Therefore, when SKF recommends a particular type of bearing, you may be sure that its recommendations are unbiased—*the right bearing in the right place.*

SKF INDUSTRIES, INC., PHILA., PA. 6003

How many lives is a glass bulb worth?



NO, it isn't a gun or a new-style bomb. It's just about all we can show you of a special glass radio bulb that is a part of our secret military apparatus.

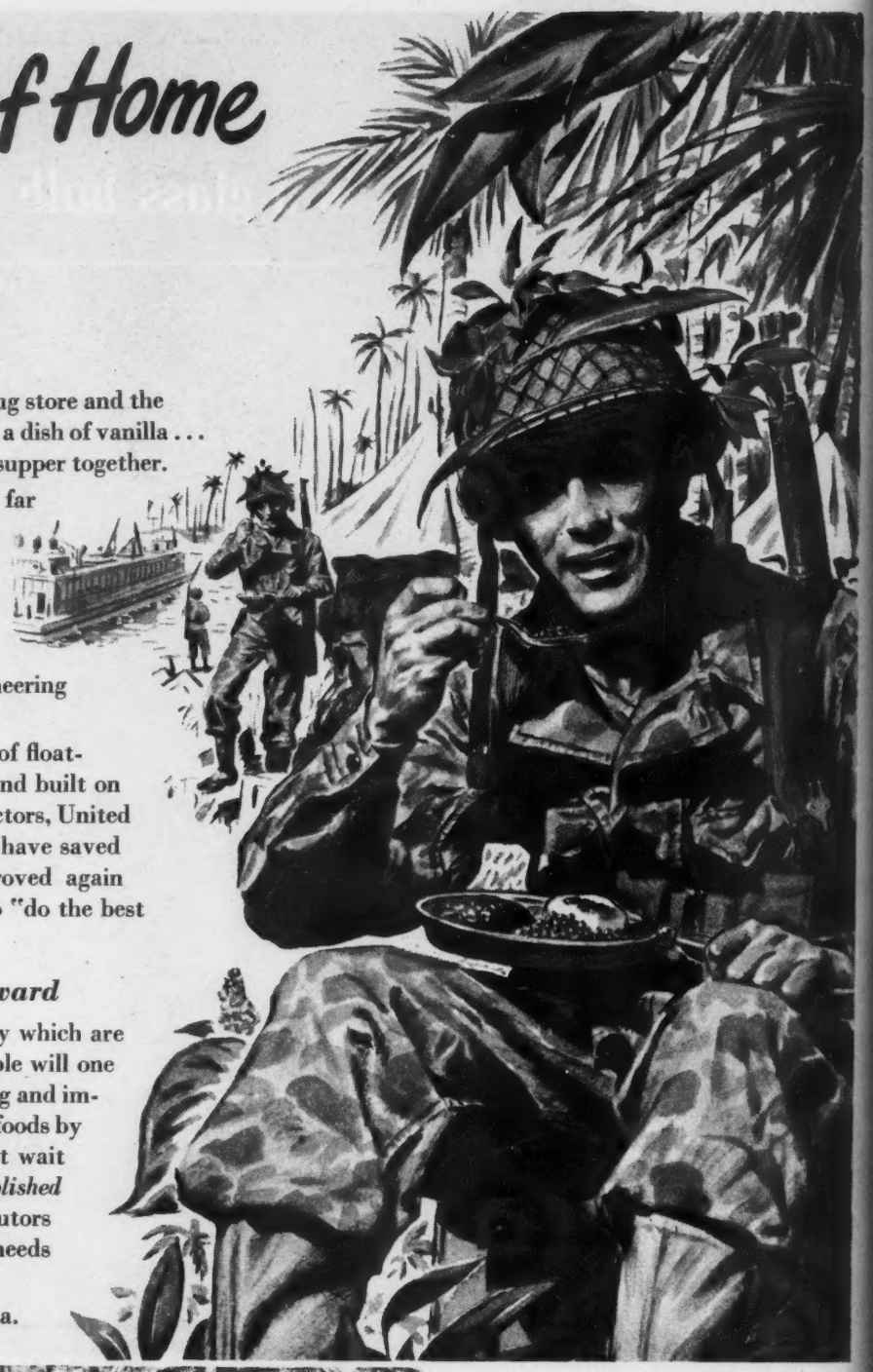
At one stage in the war a high-ranking officer stated that a bulb of this type was so valuable and effective that he would risk the lives of five soldiers to keep it in operation. That's something to think about. And it's one reason why you find Corning men and women today striving to surpass quality standards that are already exacting.

This bulb is made of a special glass to very strict requirements. And so are most of the articles Corning is making for the Army and Navy and other services. They cover a wide range—from airplane wing-tip lights to giant field marking beacon lenses. From laboratory ware for hospitals to optical glass for gunsights. From tough glass messware to thimblesize tubes for field radios.

And these are but a few of hundreds of items that Corning is making for the military services in addition to glassware for industries that supply chemicals and clothing, food, powder, rubber, and gasoline! In these fields and in many others Corning's deep knowledge of glass and glassmaking has made it possible to put this fairly plentiful material to work, not merely as a substitute, but as a new material capable of standing on its own feet and delivering better service in many instances than the one it replaces. Keep this in mind when the peacetime developments you will be working on, reach the blueprint stage—glass is amazingly versatile in the hands of people who know glass. And Corning has spent nearly a century getting acquainted with it. So, when you get to those blueprints, write us. Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

A Taste of Home



Perhaps he is thinking of the corner drug store and the old gang talking football prospects over a dish of vanilla . . . or a farmhouse kitchen and a family at supper together.

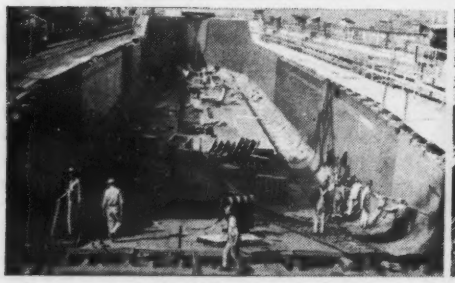
But some of these things are not as far from the lads in the remote South Pacific as you may think. Wherever possible, fresh meat, vegetables—yes, even ice cream from home are brought to them through the miracle of refrigeration and a miracle of American engineering ingenuity!

Concrete "Reefer" barges—285 feet of floating refrigerator—planned, engineered and built on the beaches by Concrete Ship Constructors, United Fruit Company and York Corporation have saved six months of ship building time—proved again that, in a crisis, America knows how to "do the best with what she has."

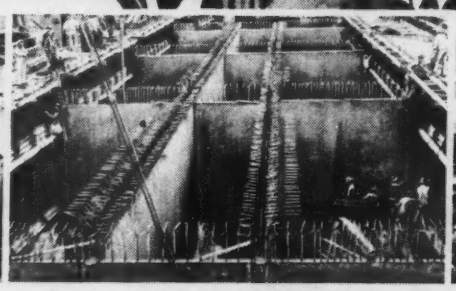
Refrigeration Looks Forward

The experience and engineering ability which are now making these achievements possible will one day return to the problem of broadening and improving the distribution of refrigerated foods by land, sea and air. But these things must wait for Victory . . . Only when it is an *accomplished fact* can York workers and York distributors turn to the job of satisfying the pent-up needs of a peacetime world.

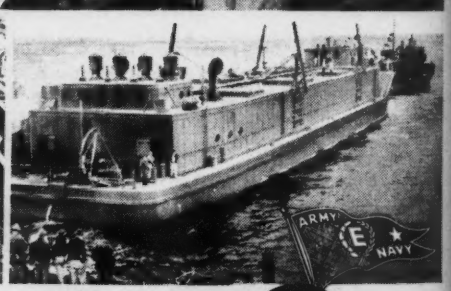
York Corporation, York, Pennsylvania.



MIRACLE OF SPEED! Just six days after keel laying this concrete "reefer" was launched. The photo above was taken a little more than an hour after construction started.



ANSWER TO THE SHIPPING PROBLEM. With shipways crowded to capacity, Concrete Ship Constructors, United Fruit Co. and York Corporation engineered and built barges on the beaches.



FIRST FLOATING REFRIGERATOR puts to sea . . . the *USS Hydrogen* heads for the South Pacific.

york refrigeration air conditioning

YORK REFRIGERATION AND AIR CONDITIONING

HEADQUARTERS FOR MECHANICAL COOLING SINCE 1885

NG
085
EWS

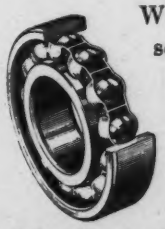
Nothing Rolls Like a Ball . . .

. . . but Mrs. J. Woofington Smith-Smythe wishes she hadn't had to demonstrate it in just that way. Especially since that fundamental fact *is* being demonstrated in *thousands* of ways in every phase of war and industry.

For the *ball* bearing carries the loads on *free-rolling* steel balls—making possible the higher speeds, heavier loads and rigidity essential to the latest developments in war and industry.

That is why over 300 million New Departure Ball Bearings are at work in this war. That is why designers of new and better machinery are designing more *ball* bearings into it than ever before.

We believe that nothing but the *ball* bearing has so many and varied advantages—in so many applications. Particularly when backed by the technical skill and experience that goes into New Departure Ball Bearings.



NEW DEPARTURE
BALL BEARINGS

3358

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT • Sales Branches: DETROIT • CHICAGO • LOS ANGELES

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GE Campus News

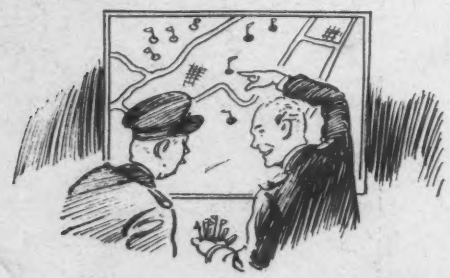
RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

HOSPITAL ON WHEELS

SOME PEOPLE—perhaps when they're very young—have a touch of tuberculosis. It may be just a spot on their lungs, which hardens and never causes any trouble. On the other hand, thirteen people out of a thousand, when examined by X ray, show evidence of reinfection tuberculosis. This does cause trouble unless it's treated at once.

G-E photo-roentgen units make it possible for public health and welfare organizations to reach and examine, not only thousands of persons in large cities, but in rural areas and thinly settled sections as well.

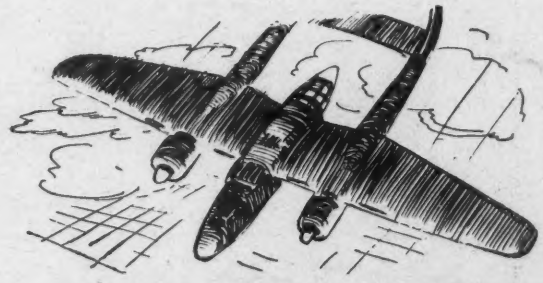
Forty-five to sixty chest X rays an hour is the record of mobile units designed and built by the G-E X-Ray Corporation. As each person takes his turn in the bus-like vehicle, a small fast-lens camera transfers his chest image from the standard size fluorescent screen onto a supersensitive 4 x 5 inch X-ray film.



MAGNETIC MAP MARKERS

LOCATING an enemy position or tracing the course of our own convoy is a war job of the alnico magnet. Both Army and Navy use G-E sintered alnico as magnetic map markers—with its aid keep abreast of vital information.

Alnico is an alloy—of aluminum, nickel, cobalt, and iron—with greater magnetic power than any other known material. To make sintered magnets G.E. begins by pressing powders of all these metals. After heating and wet grinding, one surge of current makes alnico a permanent magnet. And with a piece of steel behind the wall map, the markers can move around but won't fall off.



DEATH FROM A P-61

SOMEWHERE in the European theater of operations there is a squadron group called the Green Bats, whose Northrop P-61 Black Widow planes carry as their insigne a green bat against a yellow moon.

These Widows fight by night—with G-E remote-control gunfire. Once they let loose, the four electrically-operated .50 calibre guns can swing a deadly barrage on their target. Each plane has two sighting stations. A gunner at either of them—or the pilot himself—can take a turn at building up the high score of enemy planes downed. In the two months following D-Day it totaled 400 for the Bats—and groups like them.

General Electric Company, Schenectady 5, N. Y.

Hear the G-E radio programs: "The G-E All-girl Orchestra," 10:00 p.m. EWT, NBC—"The World Today" news, 6:45 p.m. EWT, CBS—"The G-E House Party," 4:00 p.m. EWT, CBS.

The best investment in the world is in this country's future. Keep all the Bonds you Buy

GENERAL ELECTRIC

The Murray Printing Company
Cambridge, Massachusetts